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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 152

The **Exchange Value** remained at $25.00 per pound U_3O_8 for the third consecutive month. Potential buyers continue to express a willingness to buy substantial amounts of concentrates at current prices. Additionally, a large quantity of material is presently under negotiation at about this level.

Total of inquiries to sell in the spot and near term market remained high at approximately 8.2 million pounds U_3O_8. Active inquiries to purchase in the spot and near term market increased to 2.1 million pounds U_3O_8. Much of this interest is indicated by producers who are considering entering the market as buyers.

The **Transaction Value** declined to $27.00 per pound U_3O_8 from last month's level of $27.20. Four uranium transactions are reported this month. Three of the four are spot transactions involving approximately 800,000 pounds U_3O_8 equivalent. In addition, a long term contract of between four million and seven million pounds U_3O_8 was signed between a European producer and a Far East utility.

Three sales of conversion services in the secondary market are reported this month. The **Conversion Value** remained unchanged at $1.20 per pound U as UF_6. The longer term secondary market for conversion services continued to be dominated by inquiries to buy while the near term supply remained at a relatively high level.

US uranium producers have responded to the unfavorable market situation with announcements of cutbacks and shutdowns. This month's Report summarizes the shutdowns and work force reductions over the past eight months.

Also, this month's Report contains an update on the status of disputes and litigation in the uranium industry as reported last month.

This month's *Commentary* takes a look at President Reagan's potential relationship with the nuclear industry along with the nuclear power obstacles he faces. A revised assessment of reasonably assured resources (RAR) is presented and discussed in the *Raw Materials* essay.

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PRESENTED AT:

Nuexco Luncheon
AIF Fuel Cycle Conference

March 16, 1981
Los Angeles, California

NUEXCO

Comments of:

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About a year ago, at this same AIF luncheon, I spoke before this group and offered several predictions about the behavior of the 1980 US uranium market. I would like to begin today by looking back at last year's talk.

On the consumption side, I forecast that 28.5 million pounds of U_3O_8 would be used in the US in 1980. This included 11 million pounds for US reactors which were then designated as being under construction. The prediction included 14 reactors which were "nearly ready," although we commented that probably no more than six or eight would actually receive operating licenses during 1980. In fact, only four new licenses were issued last year in the US. The Tennessee Valley Authority received a conditional full power license for its Sequoyah unit 1. Full power licenses were issued to Virginia Electric & Power Co. for North Anna unit 2 and Public Service Electric & Gas Co. for Salem unit 2. Alabama Power Co.'s Farley unit 2 was granted a low power license in early September. The effect of this licensing slowdown can be seen in the reduced US consumption level. Consumption, as defined by Nuexco, was acutally only about 18 million pounds U_3O_8 in 1980, much less than we had forecast.

On the production side, last year I said that US production would decline from the 1979 level of 37.5 million pounds U_3O_8 by as much as ten percent. In fact, US production increased to approximately 42.5 million pounds. The overall US production-consumption ratio in 1980 was 2.5. The extent of the actual market disequilibrium in 1980-1981 led to downward price pressure considerably more severe than anticipated.

The worldwide (non-Communist) picture was even worse. In 1980, world production was 110 million pounds U_3O_8 and consumption, as defined by Nuexco, was only 40 million pounds, a ratio of 2.75. Looking at these numbers, it is not surprising that the uranium price continued to fall from $35 per pound U_3O_8 (the Exchange Value at the time of last year's AIF Fuel Cycle Conference) to the current level of $25.

What caused the low level of US consumption? As I mentioned earlier, the post-Three Mile Island (TMI) licensing logjam was much greater than anticipated. Over the past two years, the number of new US nuclear power plants estimated to begin commercial operation has changed drastically. Before TMI, Nuexco estimated that 61 plants would begin commercial operation in the US during the period 1979 through 1984. Six months after TMI, the number had dropped to 50. Last November Nuexco estimated that 21 plants would start up during that time period. Today, in light of recent US NRC statements, we foresee only 17 in that category.

Given reduced consumption and falling prices, why did US production increase in 1980? One word just about sums it up. Momentum. We inaccurately estimated the short-run time lags between producers' apprehension of a deteriorating market and subsequent decisions to cut back or not to produce. Moreover, the time between such decisions and actual implementation was longer than expected.

In open pit mining, the time lag between laying-off of workers involved in stripping of overburden and running out of ore to mine is between three and nine months. The existence of ore stockpiles and a higher average ore grade (0.12 percent U_3O_8, versus 0.11 in 1979) also helped maintain production momentum. Decisions to shut down could not be made quickly and involved many factors including decommissioning and tailings cleanup cost considerations.

What is the outlook for the US in 1981? Nuexco predicts consumption in the US will be 21 million pounds U_3O_8, a small increase from the 1980 level. We anticipate US production will be about 37 million pounds in 1981. Estimated US producer contractual commitments for 1981 total 42 million pounds, a five million pound difference. Nuexco predicts at least a 30 percent drop in production in 1980 through 1982, and continuing decreases thereafter. For 1982, Nuexco anticipates US production will be at most 30 million pounds U_3O_8 to cover an estimated 37 million pounds of US producer commitments. For 1983 the current Nuexco estimates are 26 million pounds of production to cover 32 million pounds of commitments. Thus from 1981 through 1983, there may be as much as 18 million pounds of US producer commitments which cannot be met by US production presently expected. This shortfall will have to be met by a combination of purchases, rescheduling and renegotiation.

Why this expected decline in the US industry? US producers generally cannot survive at a $25 per pound price. The median US incremental production cost is about $24, not including sunk costs. Therefore about half of all US producers could not economically justify selling at today's prices, even on a marginal basis.

On the other hand, new production from Australia and production from Canada's Rabbit, Cluff and Key Lakes is expected to run at a *total* cost considerably lower than today's market price. Thus we have a US industry potentially in contraction and a non-US industry in expansion. Let's examine the industry outlook more specifically:

South Africa: When gold was above $600 an ounce, South African producers announced that they would stockpile uranium rather than sell into the weakened spot market. The price of gold has slipped to about $500. If the price of gold doesn't recover, you might look for some quiet spot selling by the South Africans.

Central Africa and France: Cogema announced some production cutbacks in France during the past year. But for political reasons expect France, Niger and Gabon to continue at close to current output.

Australia: Both Queensland Mines and Ranger are already close to being sold out. The Australia situation brings up an interesting question. Why did Japan and Germany (and other European countries) buy from Ranger? There was no apparent near term need. One answer is that the purchases were seen by the buyers as an "insurance policy" for the late 80's and 90's, and assured continued competition with Canada and South Africa.

Yeelirrie is largely committed to equity owners. As for Koongarra, if Denison goes forward with the project, one could argue that it would be to use the output to displace some Elliot Lake production. Jabiluka is the only remaining major uranium deposit which is unsold. It will probably be developed only if economic commitments can be made for the late 1980's. The by-product output of Roxby Downs will probably come about later in time.

Canada: In my mind, Canada's Key Lake is the most exciting thing happening at this time. Key Lake has an ore grade of 2.5 percent U_3O_8 in more than 150 million pounds of reserves. Production is expected to be at the rate of up to 12 million pounds annually. The Key Lake Board of Inquiry has just published its findings and all looks well to continue the development of the property.

The question to ask then is whether the Europeans and the Japanese will decide to buy this additional insurance from Key Lake and will they decide to do the same with Jabiluka?

US: In the US the situation is one of Adam Smith's *Invisible Hand* of free market competition, versus the *Visible Hand* of external forces. Why won't US utilities buy an "insurance policy" of US production? There is no mechanism for US utilities to act as a group, as there is in Japan for example. If US utilities act individually, it would probably be more of a market related action than a politically related action. Even if the utilities could act as a group, there are 51 separate Public Utility Commissions that must be willing to approve the action, also as a group. This is unlikely, barring federal preemption of electric ratemaking, or other federal action.

Is such an insurance policy necessary in the US? Perhaps not, due to the large uranium inventories of both US utilities and the US government. Also, the presence of tremendous US uranium reserves can be seen as an argument against the need for an insurance policy, however high the production cost of US uranium. The US inventories would provide the time cushion to get these US reserves into production if they were needed in the event of interruption of other sources.

Another *Visible Hand* approach would be an embargo on foreign uranium imports to aid US producers. However, this does not appear likely for several reasons:

1. Foreign competition does not appear to be a factor in the current decline of the fortunes of the US industry. The problem is insufficient consumption.

2. There is not much visible political support for an embargo. Utility and oil companies are generally not on record as being in favor.

3. Any hindrance to a free market would run counter to President Reagan's political and economic beliefs.

Finally, what is the price outlook for the near future? We have seen that the lower price of uranium has not yet removed many spot sellers from the market. In fact the total spot supply is greater now than last year. Any dramatic change in price level would probably need a dramatic event to trigger it, as TMI did in the downward direction.

SOUTH TEXAS DISTRICT—PART II

Host-Rock Geology

The Tertiary formations of South Texas were deposited in a coastal marine and continental environment. The uranium-bearing formations consist of thick tuffaceous and clay units (the Fant Tuff and Frio Clay); sandstone units (Oakville, Tordilla, Deweesville and Dillworth); and fine to coarse-grained sandstone and conglomeratic units (Goliad and Soledad). The entire sequence is characterized by oscillating depositional patterns marked by facies changes which commonly include any combination of formational deposit. Carbonaceous material and lignite may occur in light to heavy concentrations throughout the more sandy units. The predominant depositional patterns of the Eocene formations are related to beach and barrier-bar structures; the younger formations are associated with continental deposition consisting of fine to coarse sand and conglomeratic units. The source of the fine to coarse sand and conglomeratic material may have originated in West Texas and northern Mexico; the tuffs were deposited during regional volcanic activity.

Uranium mineralization is commonly found in sand and sand mud facies filling erosional channels, and in well defined beach and barrier-bar structures. The most important ore deposits are associated with depositional changes in fluvial channel environments. A greater concentration of uranium often occurs where lignite and carbonaceous material are abundantly dispersed throughout sand units, especially where permeability is relatively high. There is also an apparent relationship between the concentrations of uranium and clay minerals present in certain sand clay host units. The clay particles acted to restrict the normal flow of mineral bearing solutions and consequently afforded the rapid precipitation of uranium, enriching the clay-bearing unit. It was concluded that the uranium deposits of the district were formed by epigenetic process—placement of the uranium occurred after and totally independent of the deposition of the host formation.

The unoxidized uranium deposits of the district are significantly larger than were the oxidized deposits mined in the 1960's. Unoxidized mineralization has notably formed in anomalous concentrations along sinuous alteration fronts, or roll fronts, similar to deposits in the Tertiary rocks of Wyoming. Low-grade uranium may occur continuously for several miles along a front; however, the higher grade uranium usually occurs as discrete accumulations randomly distributed along the roll front. Molybdenum, selenium and arsenic occur as accessory minerals to the uranium in certain areas throughout the district. The accessory minerals can be useful as an exploration guide under cetain circumstances. Organic material, pyrite and clay minerals are common constituents associated with uranium.

The principal source of uranium mineralization is considered to be the thick volcanic ash (tuff) sequence of Miocene Age that covered the entire region. As the tuff formation eroded, primarily toward the gulf, the contained uranium was leached from the tuff to be absorbed and transported downdip by oxygenated ground water. Precipitation of the uranium in a favorable host rock occurred in a reducing environment. The reducing environment was probably created by the upward migration of hydrogen sulfide and or methane gas associated with deeper deposits of oil and gas. Formation permeability and faulting are the main factors controlling the migration of the reductants to the surface; thus offering a guide to exploration.

The ore minerals common to the district are both oxidized and unoxidized. The first mining was from shallow open pit mines (average depth about 40 feet) situated along a trend from Deweesville, through Tordilla Hill, and into Live Oak County. About 200,000 tons of ore averaging 0.20 percent U_3O_8 were mined between 1960 and 1964, nearly all of which was oxidized. The principle uranium minerals were autunite—a calcium phosphate of uranium, and tyuyamunite—a calcium, uranium vandate. Carnotite—a uranium vandate, was present in minor amounts. Trace amounts of the unoxidized mineral uraninite—a nuranium oxide, were noted in isolated occurrences, usually in the lower contact portion of the deposit.

The Mabel New deposit was the most important oxidized deposit mined in Live Oak Country. The average depth of the deposit was 90 feet, about 50 feet deeper than the oxidized deposits near Deweesville. The characteristics of Mabel New ore were completely different from other deposits. The ore minerals were boltwoodite—a uranium potassium silicate, and weeksite—a uranium potassium silicate high in calcium. The ore occurred as a bedded deposit in a host rock of ferruginous sandstone. The deposit was

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enclosed in a thin bed of fine-grained sandstone tightly cemented by calcite. It was the only deposit of this type in the district.

Unoxidized mineralization was discovered one to two miles downdip from the oxidized deposits in Karnes County in 1963. The principal host for such ores is fine-grained arkosic sandstone and clayey sandstone in beach environment and fluvial channel fill. Most of the unoxidized ore occurs in roll front-type deposits, with the unoxidized zone and the thickest and richest ore on the downdip side of the front. The main ore minerals are uraninite—a uranium oxide, and coffinite—a uranium silicate. Associated minerals consist of molybdenum, selenium and pyrite. The largest and most important ore deposits along the trend are completely unoxidized and occur in the Oakville Sandstone in Live Oak County.

Roll front deposits in sandstone facies of fluvial channels within the Soledad member of the Catahoula Tuff are important in Duval and Webb County. Ore grade mineralization is known to occur at depths of 2,000 feet or more in the Oakville and Catahoula formations; however, the deepest solution mining is currently between 600 and 700 feet. Due to the depth and low grade nature of certain deposits, in situ solution mining is considered the most practical method of recovery. Table 7 illustrates the geologic sequence of all uranium-bearing formations with relation to rated economic importance of each formation and the main area of mining activity.

Generally, the oxidized ores were characterized by an equilibrium difference between detectable radiation and actual uranium content of the ore. Detailed evaluation of a deposit by core drilling and chemical assaying of samples became an important procedure in final orebody studies. Exploitation of a deposit was dependent upon the proper interpretation of the disequilibrium factor. The problem of disequilibrium in unoxidized ore deposits has been minor to non-existent; even so, project evaluation procedures usually include precautionary measures such as core

Table 7

GEOLOGIC SEQUENCE OF THE URANIUM-BEARING FORMATIONS IN THE SOUTH TEXAS DISTRICT RATED BY ECONOMIC IMPORTANCE OF URANIUM DEPOSITS AND SHOWING THE PRINCIPAL AREAS BY COUNTIES.

Geologic Age	Geologic Unit	Economic Rank	County
Pliocene	Goliad Sandstone	1	Live Oak, Duval
Miocene	Fleming Formation		
	Oakville Sandstone	1	Karnes, Live Oak, McMullen, Duval, Jim Hogg, Dewitt
Oligocene	Catahoula		
	Chusa Tuff		
	Soledad Conglomerate	2	Duval, Webb
	Faut Tuff	5	Live Oak, Duval
	Frio Clay	6	Live Oak
Eocene	Jackson Group		
	(Whitsett Formation)		
	Fashing Clay		
	Tordilla Sandstone	3	Karnes, Wilson, Atascosa
	Dubose		
	Dewessville Sandstone	3	Karnes, Gonzales, Wilson, Fayette
	Conquista Clay		
	Dilworth Sandstone	6	Karnes

drilling and chemical assaying of core samples to determine if an equilibrium problem exists and what must be done to compensate for it.

Mining Activities

Approximately 6.7 million pounds U_3O_8 were produced in the South Texas district during 1980, making it the third largest production center in the U.S. Over 3.1 million pounds U_3O_8 were produced by open pit mining and conventional milling and about 3.6 million pounds by in situ solution mining techniques. In all, the South Texas district has existing production capacity for a total of at least nine to ten million pounds U_3O_8. However, it is unlikely that production for the next few years will exceed the 1980 level. Conventional production centers have already curtailed operations, or have plans to do so, and more than two-thirds of the 14 in situ solution mining projects are operating below design capacity.

The largest conventional mining and milling operation in the district is the Conquista project which is controlled by Conoco and Pioneer Nuclear. Conoco is project operator. A 3,500 ton per day mill located at Deweesville, Karnes County is the center of activity. As of January 1981, project operations included 12 active mines in various stages of stripping, mining and pit reclamation in Karnes, Live Oak and Gonzales Counties. Operating depths are from 120 to 200 feet. (Figure 1 shows the stripping procedure at one of the Conquista projects.) Conquista currently has 27 active mining permits out of a total 36 issued to date. Even though project operations were curtailed 50 to 60 percent on January 1, permit number 37 for another open pit mine is pending. Past mining from the Whitsett formations has occurred in Wilson, Dewitt and Atascosa Counties. Figure 2 is a photo of the specialized equipment used by Conquista for mining ore.

Chevron Resources Company operates a 3,000 ton per day mill located at Panna Maria in eastern Karnes County. Mill feed is mined from three open pit mines at depths of 120 feet to 180 feet in the Whitsett sandstone units. Chevron has also applied for a mining permit on the Jack Pump ore deposit located about 16 miles northeast of the Panna Maria mill site. In a significant move to enhance uranium operations in the district, Chevron announced in December 1980 that it had signed a letter of intent with Union Carbide Corporation for the purpose of purchasing all mineral interest controlled by UCC on the Palangana and Rogers properties. It is contemplated that the ore reserves on the Rogers lease could be mined by open pit methods; the Palangana deposit will probably be mined by in site solution methods, although open pit mining could be a consideration.

The Anaconda et al joint venture has proposed an open-pit mine and conventional mill for the large ore deposit located on the Rhode Ranch in McMullen County. The original proposal indicated the mine and mill would support a production rate of 2,000 tons per day. However, it was announced in December 1980 that the project would be delayed indefinitely, pending improved market conditions for uranium. All property evaluation was discontinued at that time.

In situ solution mining, or in situ leaching, technology has advanced rapidly since it was first tested in the district about 1968. It is a highly sophisticated recovery method today, applied by 8 different companies or joint ventures at 14 fully operational in situ leach projects. One pilot plant is operating, two additional plants are under construction, three are in the permitting stage and one more has been proposed. Figure 3 shows the location, project status and ownership of each mining property along the mineral trend.

Uranium recovery for each plant is a function of the flow-through rate of lixiviant given in gallons per minute times the concentration of uranium in the feed. The recovery of uranium from the lixiviant is incidental to the actual leaching process. Throughput of a full production plant varies from about 500 gpm to about 10,000 gpm. Pilot plant operations are usually designed for initial flow below 200 gpm subject to one or two incremental increases to attain the desired throughput level. Upgrading a plant from the pilot stage to a satisfactory production level can be accomplished in six to nine months, depending upon testing time and required process modifications.

Actual U_3O_8 production by in situ solution mining for 1980 varied from less than 50,000 pounds U_3O_8 at the smaller operations to about one million pounds at the largest operations. The average production rate in 1980 for each of the 14 in situ plants was 257,000 pounds U_3O_8. One of the smaller operations is producing U_3O_8 by a modified in situ solution mining technique. Solution Engineering, Inc. is engaged in reclamation of residual uranium from impounded mill tailings at the Susquehanna Western, Inc. site near Falls City. The tailings are being treated by a

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Figure 1
HEAVY EQUIPMENT UTILIZED IN THE STRIPPING PROCESS AT CONQUISTA PROJECT MINES

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Figure 2
SPECIALIZED EQUIPMENT USED FOR ORE REMOVAL AT CONQUISTA PROJECT MINES

method called in situ heap leaching.

Leaching solution contact with the tailings is accomplished in a manner similar to conventional in situ solution mining. Well patterns are strategically located over the tailings to service the area to be leached. The residual acid content of the tailings provides the leaching agent which extracts already soluble uranium from the porous tailings. Feed to the recovery plant varies with the areas being leached, but generally contains 20 to 40 parts per million U_3O_8. The recovery plant has a capacity of 800 gpm featuring a counter-current continuous ion exchange system and subsequent system to produce dry yellowcake.

Summary

Participation in exploration and development throughout the South Texas district has continued to gain favor because of exploration success and workable industry regulations. Several distinct mineral trends have been developed to date and new trends have been discovered at greater depths. Drilled reserves of the district are estimated by Nuexco at 140 million pounds U_3O_8; the potential to increase reserves by 50 percent is considered good to excellent. The new trend developing in the Oakville Sandstone through Jim Wells and the eastern part of Duval Counties has much potential. It is inevitable that exploration efforts will migrate eastward to test each uranium-bearing formation at ever-increasing depths.

New property development is completely under the jurisdiction of state agencies. The Railroad Commission of Texas is primarily responsible for open-pit mines; the Texas Department of Water Resources has the responsibility for in situ solution mining; the Department of Health and the Air Control Board contribute to final environmental requirements. Texas is an Agreement State and the Nuclear Regulatory Commission and the Environmental Protection Agency have only indirect jurisdiction. State agencies work in close cooperation with the industry to allow exploitation of uranium deposits. As a result, development of new properties has been steady during the last few years and the district has become one of the most active in the U.S.

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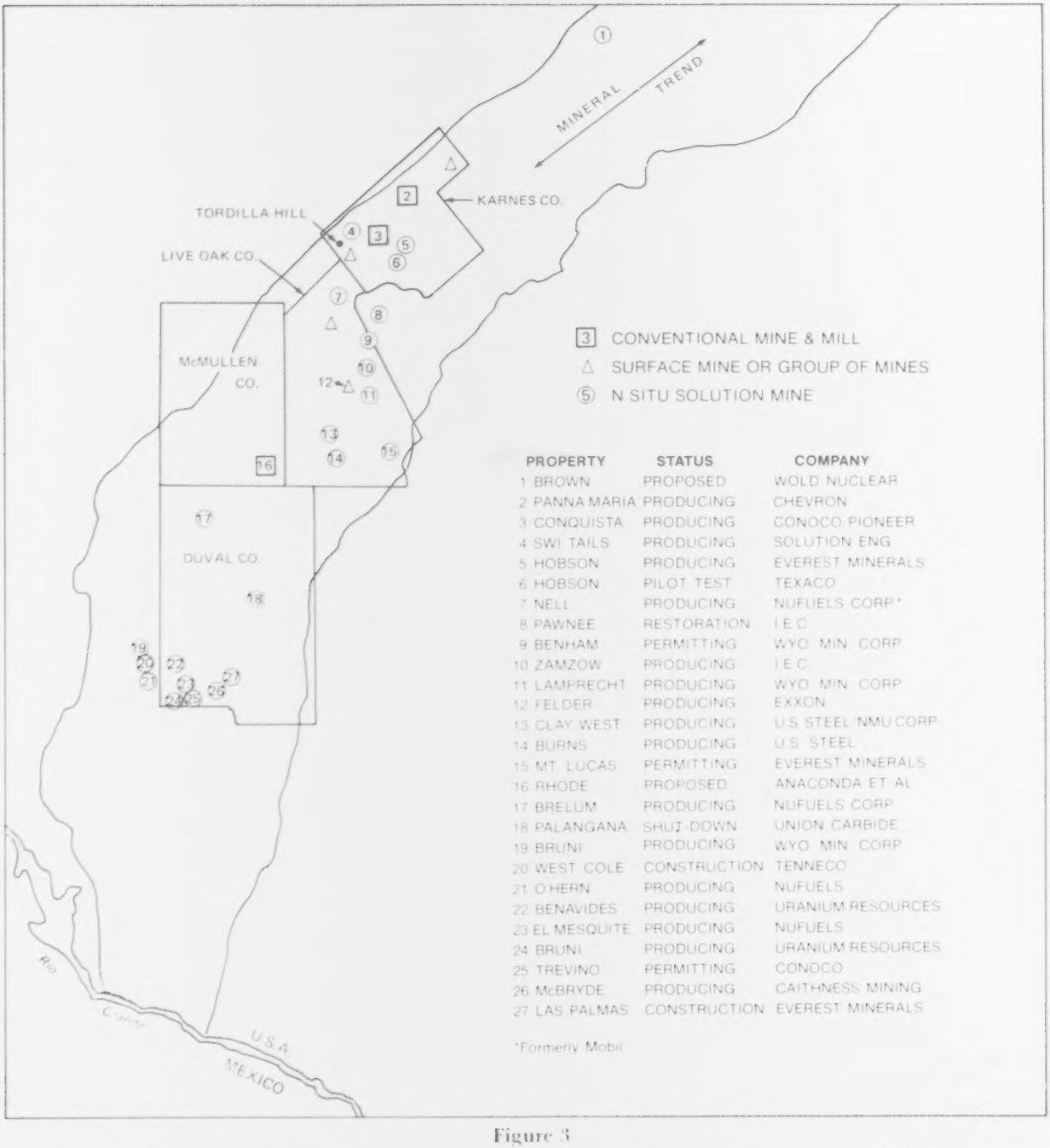
RAW MATERIALS



PROPERTY	STATUS	COMPANY
1 BROWN	PROPOSED	WOLD NUCLEAR
2 PANNA MARIA	PRODUCING	CHEVRON
3 CONQUISTA	PRODUCING	CONOCO PIONEER
4 SWI TAILS	PRODUCING	SOLUTION ENG
5 HOBSON	PRODUCING	EVEREST MINERALS
6 HOBSON	PILOT TEST	TEXACO
7 NELL	PRODUCING	NUFUELS CORP*
8 PAWNEE	RESTORATION	I.E.C.
9 BENHAM	PERMITTING	WYO. MIN. CORP.
10 ZAMZOW	PRODUCING	I.E.C.
11 LAMPRECHT	PRODUCING	WYO. MIN. CORP.
12 FELDER	PRODUCING	EXXON
13 CLAY WEST	PRODUCING	U.S. STEEL NMU CORP.
14 BURNS	PRODUCING	U.S. STEEL
15 MT. LUCAS	PERMITTING	EVEREST MINERALS
16 RHODE	PROPOSED	ANACONDA ET AL
17 BRELUM	PRODUCING	NUFUELS CORP.
18 PALANGANA	SHUT-DOWN	UNION CARBIDE
19 BRUNI	PRODUCING	WYO. MIN. CORP.
20 WEST COLE	CONSTRUCTION	TENNECO
21 O'HERN	PRODUCING	NUFUELS
22 BENAVIDES	PRODUCING	URANIUM RESOURCES
23 EL MESQUITE	PRODUCING	NUFUELS
24 BRUNI	PRODUCING	URANIUM RESOURCES
25 TREVINO	PERMITTING	CONOCO
26 McBRYDE	PRODUCING	CAITHNESS MINING
27 LAS PALMAS	CONSTRUCTION	EVEREST MINERALS

*Formerly Mobil

Figure 3
LOCATION, STATUS AND PRINCIPAL OWNERSHIP OF MINING PROPERTIES ALONG THE SOUTH TEXAS URANIUM TREND

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FOREWORD

The definition of the Conversion Value has been reworded this month to more accurately describe the data on which it is based.

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URANIUM MARKET

GENERAL

Issues concerning waste storage and disposal, including Away From Reactor (AFR) legislation, continue to be debated within the US Department of Energy (USDOE), the US Congress and among the American public. Meanwhile several European nations continue to proceed with research and testing and are putting disposal technologies into practical application. The use of geologic formations for disposal is being pursued in many European countries and the European Economic Community (EEC) is financing a joint program of study in this area, with different countries emphasizing various geologic approaches. The following is an update of the situation in Europe.

France:

France is probably making the most notable progress in practical application of technology. It is reprocessing its spent fuel and applying its highly developed technology, known as AVM, for vitrifying separated high-level waste. The AVM facility began operation with radioactive waste in June 1978. The facility produces glassified waste encapsulated in stainless steel canisters, which are stored in air-cooled pits adjacent to the processing plant. A similar waste processing plant is being designed for operation at Cogema's La Hague reprocessing plant.

France has an adequate interim storage system for vitrified high-level waste cylinders and is currently considering salt, crystaline rocks and argillaceous (clay) material for permanent waste disposal. An experimental repository is being discussed for completion within ten to 20 years.

United Kingdom:

The back end of the fuel cycle in the United Kingdom utilizes the British Nuclear Fuels, Ltd. (BNFL) Windscale reprocessing plant handling Magnox fuel. BNFL is storing light water reactor (LWR) fuel received from other countries until construction is completed at its new THORP reprocessing plant, designed to handle LWR and Advanced Gas-Cooled Reactor (AGR) fuels.

BNFL is focussing its research and development on solidification and permanent disposal of high-level wastes. These wastes are currently being stored in a liquid form in water-cooled stainless steel tanks at the Windscale site. Solidification is achieved by converting the radioactive liquid wastes into a highly durable glass. One process for this vitrification, the Fingal Harvest process, has been demonstrated with actual waste from Windscale. Pilot plants and industrial-scale facilities are being developed using this method.

Efforts toward final geologic disposal of the vitrified wastes include feasibility studies of various rock formations, primarily granites. There are current proposals to drill test holes in the Cheviot hills along the English Scottish border and in other areas of England as well. A conceptual design for a hard-rock repository is proceeding in parallel. A demonstration facility is planned for the 1990's with a full-scale repository targeted for the following decade. The United Kingdom is also directing effort toward deep-ocean disposal.

Federal Republic of Germany:

Nuclear fuel and waste disposal have been highly emotional issues in Germany, where control over programs resides as much with the states as it does with the federal government. The Biblis A and B nuclear plants were threatened with extended shutdowns for lack of ability to obtain state licenses for high density on-site spent fuel storage racks. The utility RWE recently signed a long-delayed reprocessing contract with BNFL to assure alternate storage capability.

Although most German utilities hold reprocessing contracts, most of the arrangements do not extend beyond 1984 or 1985. Intermediate storage, new reprocessing contracts or other solutions will be required by 1985. Reprocessing contracts with BNFL and Cogema require return of the waste to Germany, probably in glassified form sometime after 1990. In addition, Germany has plans to build its own reprocessing plant.

Salt domes have been selected as the preferred geologic media for disposal of the wastes from reprocessing. Initial disposal would be designed to be retrievable and final disposal would await further development and testing of geologic areas.

The German company DWK plans to build storage facilities at Gorleben and perhaps Ahaus. Both will be "dry" storage facilities with the fuel in casks or flasks. The cask designs have been tested and have been given preliminary licenses. An operating license for the storage area may be granted by mid-1981, which would mean start-up could be as early as 1983.

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However the anti-nuclear activity associated with the Gorleben site may delay these plans significantly.

To further study the waste disposal issue and to permit emotions to subside, Bonn's research ministry last year made plans for a $28 million program to effect decisions regarding the future of its nuclear waste storage by 1984.

Sweden:

Sweden has a law requiring that utilities have contracts for the reprocessing of spent fuel and for storage of the waste from such reprocessing as a prerequisite for nuclear plant start-up. This 1976 law applies only to the last seven plants of the 12 now committed for Sweden.

Sweden is building a temporary storage facility, referred to as CLAB, at the Oskarshamn site. This facility will eventually be able to store up to 3000 tons of spent fuel. The first phase, for 1500 tons, is expected to be ready in about 1985 or 1986. It has the design capacity to store all the fuel from the 12 reactors for up to 12 years. In parallel with building temporary storage for the spent fuel, Swedish electric power companies have entered into contracts with Cogema and BNFL for reprocessing. These contracts require that Sweden take back the waste from reprocessing for final storage in Sweden, but probably not before the early 1990's.

As to final waste disposal, Sweden has been carrying out a number of studies leading to probable storage in deep crystalline rock. One such study is the "stripa" program in conjunction with the USDOE. Very thorough research by a group of Swedish utilities concludes that both vitrified waste encapsulated in lead and titanium, or spent fuel encapsulated in copper canisters buried 1500 feet underground in crystalline rock will isolate the wastes from the environment for hundreds of thousands of years.

Switzerland:

The nuclear plants in Switzerland already have high density fuel storage racks to allow storage of spent fuel for a period of about five years. The Swiss utilities have contracts for reprocessing their spent fuel with Cogema and BNFL. The Swiss utility BKW recently received approval from the US to have some of its spent fuel reprocessed by Cogema where the fuel is in storage. Spent fuel from the Swiss utility NOK has been shipped to storage pools in England but reprocessing is not expected to be performed for about ten years. Each reprocessor has the option of retaining the waste from reprocessing or shipping it back to Switzerland. The exact form in which the waste would be returned is not yet determined, but would likely be calcined or glassified.

The Swiss are planning construction of long term storage facilities in various geologic formations. Granites appear to have the most promise but anhydrites, argillaceous formations and crystalline rocks other than granites are being studied. Switzerland's agency responsible for radioactive waste storage has a target date of 1985 for identification, safety analysis and engineering of a specific site or sites. Expenditures of more than $125 million over the next five years are planned.

Italy:

Latina fuel will be shipped to BNFL for reprocessing. Trino and Garigliani fuel will be stored in an AFR, developed from a former research reactor facility. Caorso fuel will be stored in on-site high density storage for about ten years.

The Italians are waiting for a determination of a national plan on spent fuel before further arrangements are made. At one time Italy planned to build its own reprocessing plant but this seems unlikely now.

In its waste management program, Italy is concentrating research on the disposal of radioactive waste in argillaceous formations in Southern Italy. Operations for a test repository are expected to start in the mid-1980's.

Belgium:

Currently, Belgian spent fuel is being stored on-site. The Belgian nuclear industry has proposed to reprocess about one-third of its spent fuel at the Eurochemic facility at Mol and the balance at Cogema's plant. The Belgian parliament has been asked to make a decision on this issue by the end of 1981. Research into the disposal of radioactive waste is focused on the potential use of argillaceous formations.

Holland:

The Dutch utilities have reprocessing contracts with BNFL and Cogema which require that the waste products be returned to Holland. However, nuclear opposition in the country is strongly against domestic storage of such wastes.

The Dutch parliament is currently discussing not only the waste storage issue but the future of the

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entire nuclear program. A period of public debate is planned before a final decision is made. This debate period may last as long as two years and thus a firm Dutch nuclear position is not expected very soon.

An active geologic waste isolation program is concentrated on salt dome repositories sited on state-owned properties. The Dutch commissioned seismic tests of salt domes in the Dutch sector of the North Sea in March of this year to determine their suitability for radioactive waste disposal.

Finland:

The private utility group TVO has on-site storage to accommodate about ten years of spent fuel. TVO is also negotiating to store fuel at the Swedish CLAB storage center as well as encouraging an interim centralized AFR storage facility in Finland. The state-owned utility IVO has two Russian-supplied nuclear plants and arrangements which require the spent fuel to be returned to Russia. A study is being conducted which will lead to final long term storage of spent fuel. There are currently no plans to reprocess the fuel.

Spain:

Spain has on-site spent fuel storage capacity adequate for the near-term needs of its new nuclear plants. The country has reprocessing contracts for its four operating nuclear plants. Consideration is being given to an AFR facility as well. Spain has not yet focused much attention on long term waste disposal.

AFRICA

First quarter figures from South African producers have been released and while total uranium production remained unchanged from the previous quarter's 1859 metric tons, profits were down substantially.

Vaal Reefs, South Africa's largest producer, reported a 19 percent decrease in profits from uranium sales this quarter, as compared to the previous quarter. Production from the Afrikander Lease section was down 66 percent from the previous quarter due to ore stockpiling. The ore is being accumulated in order to commission the new 50,000 ton-per-month plant at Afrikander Lease during the first half of 1982. The chairman of Afrikander Lease has stated that the sales contract for the company's 1984 through 1990 uranium production, signed in 1980, might be supplied by Vaal Reefs from its own sources and at production costs well below those of Afrikander Lease. In this event, the mineral lease agreement between Vaal Reefs and Afrikander Lease would be renegotiated to ensure that royalty receipts would be shared in the same way as would have been the case had Afrikander Lease been the supplier.

An industry perspective on the uranium market was recently put forth by Mr. D. A. Etheredge, Chairman of Anglo-American's gold and uranium division. Mr. Etheredge attributed the past year's dramatic decline in uranium spot prices to reduced projections of demand for power generation, the development of new high-grade ore bodies and US utility inventory sales. While anticipating an increase in uranium inventories in the medium term, he forsees a longer term change of direction in the trends of supply and demand. He also mentioned the aggressive Australian pricing policy and general utility desire for diversified suppy sources as factors with which South African uranium producers must contend.

Mr. Etheredge pointed out to shareholders that the declining uranium spot price was accentuated in South Africa by the appreciation of the rand relative to the dollar. He acknowledged that improvement in spot prices was unlikely and mentioned customer pressure to modify existing contracts as a corollary to the situation.

AUSTRALIA

The action of the Seaman's Union effectively to ban the shipment of uranium from Australia is not expected to have serious or long term ramifications. To place the situation in perspective, minerals represent nearly 40 percent of Australia's export income. Given this importance, it is clear that the Australian government desires to maintain its reputation as a reliable supplier. Thus it is unlikely that the situation will be permitted to proceed unchecked. At the same time, government intervention is not expected until the various industry-labor alternatives have been fully explored. For the short term there are other methods of moving the modest amount of concentrates out of the country including air shipment, the use of foreign-crewed vessels and the use of alternate ports of export.

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URANIUM MARKET

The government of the Northern Territories has suspended all plans for a nuclear station near Darwin on both economic and constitutional grounds.

The Uranium Enrichment Group of Australia (UEGA), a joint-venture by several Australian companies, is shortly expected to file its findings with the government concerning the possibility of establishing a commercial uranium enrichment industry in Australia. It is anticipated that the report will recommend a full scale feasibility study and that the study will begin near year-end.

Euratom member nations are now reviewing the Australian bilateral safeguards agreement and formal approval is expected in the next few weeks. In the meantime, it is expected that negotiations towards a similar safeguards agreement between Japan and Australia will be resumed.

Minatome Australia Pty., Ltd. has encountered a setback in the development of the Ben Lomond deposit in Queensland. The mining warden has recommended that the company's application for a large additional lease be rejected. The land was to have been used for the location of the mill, tailings dams and evaporation ponds.

The state goverment could overrule this recommendation but will likely require new ground investigation before doing so. Although the present Queensland goverment is strongly pro-development including pro-uranium, state legislation provides for a wide range of Aboriginal and environmental matters and any action must be determined with the various interests taken into account.

At Mary Kathleen Uranium Ltd.'s annual meeting the chairman hinted that mine closure might occur 18 months ahead of schedule due to the current low price of uranium. Ore which is potentially economic will have been completely mined by mid-1983. This announcement reenforces the government position that further development of the Australian uranium industry depends on consumer demand as expressed in the conclusion of long term contracts.

CANADA

At the annual meeting of Rio Algom Ltd., it was reported that the Panel uranium mine and mill at Elliott Lake are now in normal operation with a high level of performance. Because of startup problems which were not corrected until late 1980, profitability of the Panel operation was not achieved until the last four months of the year.

Construction at the Stanleigh property is also on schedule and within budget, with production planned to begin in 1983. Through the end of March 1981, $137,000,000 has been spent or committed. The financing is being provided by Ontario Hydro, which has contracted for the total production from Stanleigh.

Long term contracts involving the supply of uranium from Saskatchewan are finally beginning to materialize. Marketing efforts have been very aggressive. It is understood that agreements in principle have been reached between Canadian sellers and both Japanese and US buyers. Several contracts are expected to be completed and signed within the next few months.

FAR EAST

The release, due to operator error, of radioactive waste water at Japan Atomic Power Co.'s Tsuruga station received considerable media attention, including charges that the incident was the subject of a cover-up. Despite the public attention, the release itself was not serious and will have no real effect on Japan's nuclear program. The likely outcome includes reassignment of certain personnel, tightening of inspection and reporting procedures and compensation payments to the local marine industry for lost business.

On a more positive note, Kyushu Electric Power Co.'s 559 MWe Genkai unit 2 was successfully brought on line in late March 1981 bringing Japan's nuclear capacity to 15,676 MWe.

Continuing the trend evident in recent market price negotiations, it is understood that 1982 deliveries from Southern African suppliers to Japanese customers will be priced somewhat lower than 1981 deliveries. Thus while prices under long-term supply contracts with provisions for negotiation of market price tend to move in the same direction as spot prices, their movement is usually more gradual and less erratic.

Discussion of Japan's nuclear program appears in the *Topical Essay* section of this month's Report

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URANIUM MARKET

UNITED STATES

The two previous Monthly Reports (Nos. 151 and 152) have summarized and updated the status of uranium industry litigation. Further developments during April were as follows:

1. Westinghouse Richmond case: this long running dispute was concluded as Westinghouse and Long Island Lighting Company (LILCO) reached agreement on a settlement. LILCO will receive cash ($51 million), discounts on products and services and an option to purchase one million pounds U_3O_8 over a five-year period.

2. Westinghouse Chicago case: Additional settlements have been reached by Westinghouse with Phelps Dodge Corp., Anaconda Co. and Western Nuclear, Inc. Counter claims by the latter two defendants were also settled. Details of these settlements are unknown at this time, but based on past record, will probably involve Westinghouse receiving money, uranium or some combination thereof.

Thus, officially only Australia's Queensland Mines Ltd. and Englehard Minerals and Chemicals Corp. remain as defendants in this case. However, based on recent public statements by Westinghouse, it appears that a settlement with Queensland Mines has also been effected, although not yet announced. In view of the pace of settlements during the past few months, it is anticipated that the entire affair will soon be concluded.

A recent announcement added Exxon Minerals Co. to the long list of US producers cutting back uranium production due to depressed market conditions. Production at Exxon's Highland uranium complex near Douglas, Wyoming will be reduced about one-third, as will the number of employees. The mill, running at a level of 3,200 tons per day, will go to a ten days on, four days off cycle. Overburden stripping at the surface mine will be cut back one-half in 1981.

It was announced this month that United Nuclear Corp. (UNC) had sold off its interest in the UNC-Homestake Partners operations near Grants, New Mexico to Homestake Mining Co. UNC originally owned 40 percent of the four uranium mines and one mill. The price to Homestake was 20 million dollars for the properties and three million dollars for yellowcake inventories.

TRANSACTIONS

There are six uranium transactions reported this month. A longer term sale of between six and ten million pounds of Australian U_3O_8 was concluded with a European utility consortium. The transaction involved a resale of material by European equity owners of Energy Resources of Australia (ERA). A sale of between 300 thousand and 600 thousand pounds U_3O_8 took place between a US producer and a US utility. Deliveries on this contract will stretch into 1982.

Two small spot quantities were sold to a US producer by two other US producers. A sale of between 100 thousand and 300 thousand pounds U_3O_8 was made between a US producer and a US utility. Finally, an agreement providing for the delivery of between 600 thousand and one million pounds U_3O_8 over the next three years from a US nuclear contractor to a US producer was completed.

There are two conversion transactions reported this month. One concerns the sale of between 600 thousand and one million pounds U of conversion in the period 1982-1983. The seller is a US nuclear contractor and the buyer is a US utility. A second transaction involves between 100 and 300 thousand pounds U of conversion for 1981 delivery. The parties are two US utilities.

PRICING

The **Exchange Value** as of April 30, 1981 is $25.00 per pound U_3O_8, unchanged from the three previous months. The most important factors considered in the determination of this month's Exchange Value were:

1. More than ten million pounds of concentrates are still under negotiation at prices approximately equal to the current Exchange Value.

2. A large transaction closed recently at about Exchange Value.

3. Nuexco continues to receive indications that producer-buyers could add significant new near term and intermediate term demand as they evaluate their options at what is apparently a very attractive price level.

4. In last month's Report, Nuexco noted that some price weakening had begun to appear as some sellers offered material at prices somewhat below Ex-

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change Value. That trend continued during April, in which some transactions occurred at less than $25.00. Those transactions involved several hundred thousand pounds U_3O_8, a quantity which would be significant in some cases but is commercially insignificant in today's market.

Material available for near term delivery as listed in the *Market Opportunities* section of this Report, total 7.06 million pounds U_3O_8. Active inquiries in the same time frame to purchase amount to 1.55 million pounds U_3O_8. Available near term supply remains at the highest level in recent years. Approximately one-half of this near term material is being offered by primary producers; the balance is being offered by holders of inventory.

The **Transaction Value** declined to $25.70 per pound U_3O_8 from last month's level of $27.00. Four qualifying transactions took place; transactions from 1981 account for approximately two-thirds of the material which went into this month's calculation of Transaction Value. Transactions from the fourth quarter of 1980, when prices were substantially higher than today's Exchange Value, which dominated last month's Transaction Value, accounted for only one-third of the material included in this month's Transaction Value.

CONVERSION

The secondary market for conversion services maintained its high level of activity during April. The market continues to be grossly imbalanced in the spot and near term. As presented in the *Market Opportunities* section of this Report, demand for secondary market conversion services within the next year totals 200,000 pounds U as UF_6. Supply in the same time frame totals 2.25 million pounds U as UF_6.

The preponderance of sellers are utilities wishing to obtain concentrates through deconversion of their UF_6 inventories with the eventual aim of selling the material. The concentrates are more salable in today's market. The low demand in the near term occurs in part because most utilities in need of converted material in the upcoming year have already covered their conversion needs.

The supply-demand imbalance appears to decrease in the next several years. However the spot supply, if not sold, will continue to be available and could be pushed into the longer term thus sustaining the unequal supply-demand ratio and continuing pressure on the market. There is presently a strong demand for long term secondary market conversion services.

Most of the potential sellers in the longer term are utilities which have contracted with a primary converter for conversion services which they no longer need. These utilities are turning to the secondary market as a means of assigning or subcontracting their conversion services contracts. Utilities with conversion requirements in the longer term have expressed interest in taking advantage of the generally lower conversion prices in the secondary market.

The **Conversion Value** increased 20 cents to $1.40 per pound U as UF_6. The recent upward price movement in the midst of a supply overhang can be explained by the fact that those sellers willing to deconvert at lower prices have gradually been removed from the market as transactions have taken place. In addition, the incurred costs of implementing a deconversion swap or contract reassignment, including storage costs, have been receiving more attention from sellers now active in the market.

Two transactions for conversion services in the secondary market closed this month at around Conversion Value. The prices for conversion services in the longer term secondary market are generally higher than Conversion Value which by definition expresses the spot and near term price.

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TOPICAL ESSAY

WORLD DEMAND: PART II, NON-US

In Nuexco Report 151, the *Topical Essay* dealt with the differences between Demand and Apparent Future Consumption (AFC) in the United States. This essay continues the discussion by presenting Nuexco's estimate of demand in the non-US free world countries.

AFC is Nuexco's calculation of the portion of demand which corresponds to reactor requirements. It is compiled and computed on a reactor by reactor basis, with the quantities for each reactor being based on specific core characteristics, 0.25 percent tails assay, no recycling, 24 month lead time for procuring first cores and 18 month lead time for procuring each reload. Reloads are assumed to occur one year after the commercial operating date and annually thereafter except in those instances where alternate schedules are known to be used by the utility. Nuexco's estimates of individual reactor capacity factors are used. Thus, AFC is a strictly quantitative calculation which does not allow for inventory buildup or liquidation.

Demand, of which AFC is a significant component, includes the intangible market perceptions of each utility. Factors such as price, security of supply, political actions and inventory situations influence each buyer's view of the market. Nuexco has developed a data base which reflects these views.

The aggregate demand for non-US utilities as estimated by Nuexco is tabulated by region in Table 1. Table 2 breaks this down by presenting the difference between demand and AFC. The AFC numbers published in Nuexco Report 147 are used for this comparison. It is seen in Table 2 that demand is significantly larger than AFC in the Far East. Historically, the countries of Taiwan, Korea and especially Japan, being without indigenous resources, have placed security of supply as their highest priority. They perceive their needs to be much greater than a purely quantitative analysis would indicate.

Similarly, both the European and Other World Outside Communist Areas (WOCA) regions have demand levels in excess of AFC, although not to the degree of the Far East. The explanation for the difference lies again in the buyers' expanded perception of needs, as well as optimistic views of reactor start-up dates. Although there are many individuals within the various nuclear utility organizations who realize that the commercial operating dates and utility demand estimates are unreasonable, the utility as a whole officially holds to its target dates. The responsible fuel manager is expected to prepare for these needs, however unrealistic. This attitude is quantified in the demand category.

In one sense, the demand numbers representing buyers' perception of fuel requirements deviate from the AFC numbers even more than the quantitative difference would indicate. Specifically, there are many situations where a utility which had anticipated an early operating date for a reactor has already purchased fuel for a first core and even some reloads, but has subsequently delayed the on-line date for a number of years. In such cases, there is no demand for this already purchased material. But there is an AFC component because the algorithm states that the first core component appears two years before the operating date.

Table 3 shows the component of non-US utility demand which is currently unfilled by contracts. This has been computed on a utility by utility basis. Not surprisingly, buyers in the Far East have almost completely filled their perceptions of demand in the 1980's. The European market appears to have the most potential in the coming decade for sellers with uncommitted production, while buyers in the Other WOCA have relatively insignificant purchasing potential.

Table 4 fills out the picture by showing the portion of non-US production which is currently unsold. These figures have been compiled on a producer by producer basis, similar to the procedure used in determining utility demand. The contrast between Table 3 and Table 4 is dramatic, for it shows that on a cumulative basis there is roughly three times as much material available for sale in the coming decade as there is demand for such material.

A later essay will explore the implications of the differences between demand and AFC and will also integrate the US and non-US demand, unfilled demand and unsold production figures published in these first two essays.

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TOPICAL ESSAY

Table 1

NON-US DEMAND
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	8.0	12.4	13.7	16.2	18.2	21.0	20.9	22.3	22.1	22.5
Europe	32.3	39.5	39.6	44.9	42.8	46.8	51.2	48.0	49.1	49.0
Other WOCA	4.0	5.3	6.5	6.3	7.0	7.4	8.7	8.6	7.9	9.1
Total Non-US:	44.3	57.2	59.8	67.4	68.0	75.2	80.8	78.9	79.1	80.6
Cumulative:	44.3	101.5	161.3	228.7	296.7	371.9	452.7	531.6	610.7	691.3

Table 2

NON-US DEMAND LESS AFC
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	1.1	5.5	6.9	5.1	6.5	9.4	10.2	12.7	13.6	13.8
Europe	6.7	10.6	4.2	14.1	6.5	8.8	6.3	5.6	5.8	6.3
Other WOCA	0.9	0.2	0.6	1.2	2.4	1.5	1.2	1.6	2.3	3.0
Total Non-US:	8.7	16.3	11.7	20.4	15.4	19.7	17.7	20.0	21.7	23.1
Cumulative:	8.7	25.0	36.7	57.1	72.5	92.2	109.9	129.9	131.6	154.7

Table 3

NON-US UNFILLED DEMAND
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	0.0	0.1	0.1	0.1	0.3	1.8	1.3	4.3	3.4	6.4
Europe	1.5	1.7	3.3	3.7	3.9	5.5	5.7	6.9	8.4	7.4
Other WOCA	0.4	0.7	1.8	1.6	2.3	1.6	1.9	2.6	1.9	2.2
Total Non-US:	1.9	2.5	5.2	5.4	6.5	8.9	8.9	13.8	13.7	16.0
Cumulative:	1.9	4.4	9.6	15.0	21.5	30.4	39.3	53.1	66.1	82.1

Table 4

NON-US UNSOLD PRODUCTION
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual:	11.5	13.5	13.6	17.8	21.6	26.1	28.1	28.9	30.1	29.4
Cumulative:	11.5	25.0	38.6	56.4	78.0	104.1	132.2	161.1	191.2	220.6

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TOPICAL ESSAY

JAPAN'S NUCLEAR GROWTH: HOPE VS. REALITY

A reduced reliance on imported oil remains one of Japan's fundamental goals. Among the available alternate fuel sources, nuclear power has been selected to play a major role, and Japan continues to press forward despite slowdowns associated with lower load growth, less favorable economic conditions, more difficult and time-consuming siting and licensing procedures and Three Mile Island (TMI)—related delays.

The official nuclear capacity forecast, supported by both the government and the utility industry, remains at 51,000 MWe by the end of fiscal year 1990. Including the newly operational Genkai unit 2, Japan's current capacity is 15,676 MWe. This leaves more than 35,000 MWe to be brought on line in order to achieve the official forecast. The 35,000 MWe can be broken down as follows:

1. About 10,000 MWe are currently under construction with official operating dates scheduled between 1981 and 1986.

2. About 3,000 additional MWe have been approved by the Electric Power Resource Development Coordinating Council as part of Japan's official generating plan. Even though these units have yet to receive construction licenses, they are, nevertheless, scheduled for operation in 1985 and 1986.

3. Another 18,000 MWe are planned, but have yet to go through procedures for authorization and construction license application.

4. This leaves 4,000 MWe that have not yet reached even the planning stage.

Japan has begun to consider modifying the existing lengthy procedures involved in project authorization and safety licensing, but there seems to be no immediate solutions to the current siting and licensing problems. Without such solutions, it is doubtful whether Japan can achieve a goal of bringing on line some 2,000 MWe each year between 1981 and 1985 along with an average of 4,700 MWe annually in the period 1986-1990.

Despite the official forecast, non-official estimates for 1990 capacity continue to range in the area of 35,000 to 45,000 MWe, with a general view that the achievement of 40,000 MWe would be a very credible performance and indeed would be possible only under extremely favorable circumstances.

One development that could increase the chances to approach or meet the official target is increased cooperation among nuclear utilities. In mid-April, Kansai Electric Power Co., Chubu Electric Power Co. and Hokuriku Electric Power Co. announced their intent to organize a joint venture to promote further construction of nuclear power generating plants. The objective of the new company, tentatively called the "Noto Nuclear Development Co." is to develop a new nuclear plant site in the western part of the main Japanese island of Honshu. The site selected, known as Suzu, is located at the extreme end of the remote Noto peninsula in Hokuriku's operating area.

The announcement indicated that total generation capacity to be installed would be approximately 10,000 MWe consisting of both Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR) units. No particular schedule for construction of the plants was given in the initial announcement. Although extensive site reviews have been made over the past few years, it is expected that extended negotiations will be required to gain the agreement of local residents and environmentalists.

As conceived, the new company would be jointly owned by the three utilities and the output of the generating facilities would be shared in proportion to the capital investment of each of the three owners. Capitalization of the new company was estimated at about $1.8 billion. It is hoped that the company can be established by mid-1981. Current cost estimates for completion of the planned 10,000 MWe capacity are $13.5 billion with an additional $4.5 billion required for new transmission facilities. If achieved, the final installed capacity of 10,000 MWe will exceed that of Tokyo Electric Power Co.'s (TEPCO) Fukushima plant site. The latter, with six BWRs, (4,696 MWe) currently operating, will eventually have ten units with a total capacity of about 9,000 MWe when completed by the mid-1980's.

In a parallel development, TEPCO and Tohoku Electric Power Co. announced further cooperation in sharing nuclear generation capacity. The two utilities have adjacent service areas. TEPCO has already started construction of the 1,100 MWe Kashiwayaki unit 1, a BWR with operation scheduled for 1985. TEPCO also is well along with licensing approval for two additional 1,100 MWe BWRs, Fukushima 2 units 3 and 4, scheduled for operation in 1985 and 1986, respectively.

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TOPICAL ESSAY

TEPCO and Tohoku have reached preliminary agreement providing Tohoku with 50 percent of the output of the Kashiwayaki plant and 25 percent of the latter two Fukushima 2 units. The intent is to supply Tohoku, which currently is relying primarily on fossil fuel generation, with the more economic generation available from TEPCO's nuclear plants. Tohoku currently has no nuclear generation due to extended licensing delays of its 524 MWe BWR at Onagawa, now scheduled for 1984 operation. Tohoku's subsequent nuclear plans call for operation of its planned Maki and Namie-Odaka plants, both 825 MWe BWRs, in approximately 1989-1990. It is expected that at the latter time there may be some additional supply from Tohoku to TEPCO.

In return for the commitment to supply electricity from the Kashiwayaki and Fukushima plants, Tohoku will make a one-time payment estimated at $135 million for defrayed construction costs. In addition, TEPCO and Tohoku recently announced plans to jointly develop an 1,100 MWe BWR at the new Shimokita site in Tohoku's operating area.

This trend among Japanese utilities to cooperate more closely could prove to be extremely helpful in overcoming and licensing problems and in advancing Japan's nuclear program in a more rapid fashion.

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RAW MATERIALS

AUSTRALIAN URANIUM DEPOSITS

Introduction

The six major uranium deposits in Australia contain approximately 89 percent of the country's known uranium reserves.[1] The remaining 11 percent of reserves, which based on public information are estimated at 49,550 tonnes U_3O_8, occur in at least 11 minor deposits which are widely scattered throughout Queensland, South Australia and Western Australia. It is recognized that the smaller deposits represent only limited economic potential compared to the larger deposits; however, the fact that the deposits often occur in a totally different geologic environment increases the importance of each relative to creating new exploration potential. Historically, new exploration activities have resulted in the discovery of significant ore reserves.

The first uranium deposits mined in Australia were located in the Rum Jungle and South Alligator River districts of the Northern Territory and the Radium Hill/Mount Painter districts in South Australia. Production was initiated in 1953 and 1954 respectively. Initial production at Mary Kathleen in northern Queensland began in 1956. Approximately 15 to 20 mines were producing in Australia by the late 1950's. Mary Kathleen is the only first generation mine surviving from this early production period.

Geologic interpretation of the early deposits led exploration groups toward the larger deposits in the early 1970's. The ultimate success story relates to the northward extension of the South Alligator River district into what is now the East Alligator River district—the location of four major ore deposits. The geology of these two districts, as well as the Rum Jungle district, is very similar. The situation repeated itself in other districts as exploration spread to geologically favorable areas, resulting in some cases, to new discoveries.

[1]The six deposits containing approximately 413,000 tonnes U_3O_8 are listed as Nabarlek, Jabiluka, Ranger and Koongarra located in the Northern Territory; Yeelirrie, located in Western Australia; Mary Kathleen, located in Queensland. Reserves are defined as U_3O_8 recoverable within a given cost range based upon current mining and milling technology.

The Minor Deposits

The mode of mineral occurrence in the 11 minor uranium properties varies considerably by district. The properties are usually closely spaced, illustrating the relationship of a new discovery and follow-up exploration in a favorable geologic environment. The properties are tabulated to reflect highlights and current status of each. Figure 1 shows the geographic location of each in relation to other uranium properties in Australia.

Queensland

1. Property: Westmoreland
   - Ownership: Queensland Mines Ltd. 40.00%; Mines Administration P. L. 12.75%; I.O.L. Petroleum 9.75%; Urangesellschaft Aust. P. L. 37.50%
   - Ore Reserves: 4,700 tonnes U_3O_8 in the Garee and Jack orebodies. Grade is 0.17 percent U_3O_8.
   - Occurrence: Mineralization occurs in two tabular feldspathic sandstone units separated by a vertical dike and fault system in the Westmoreland Conglomerate of Upper Proterozoic age. The main ore mineral in the Garee zone is pitchblende; the Jack unit is dominated by secondary minerals of torbernite and carnotite.
   - Current Status: Evaluation drilling is continuing on a limited basis.

2. Property: Valhalla
   - Ownership: Queensland Mines Ltd.
   - Ore Reserves: 5,800 tonnes U_3O_8; average grade is 0.16 percent U_3O_8.
   - Occurrence: Metatorbernite occurs in a weathered portion of a steeply dipping stratabound tuff unit. Brannerite occurs in the unoxidized zone at a depth of about 35 meters.
   - Current Status: Although ore was discovered in 1954, the evaluation procedures are limited to permit obligations.

3. Property: Maureen
   - Ownership: Central Coast Exploration NL 51.00%; Getty Mining Pty., Ltd. 49.00%
   - Ore Reserves: 3,600 tonnes U_3O_8; average grade is 0.14 percent U_3O_8.
   - Occurrence: Uraninite occurs in lenticular sediments within the lower portion of the Galloway volcanics of Middle Carboniferous age. Fluorite and molybdenum occur as accessory minerals.
   - Current Status: Evaluation drilling is continuing on a limited basis.

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RAW MATERIALS

SMALL URANIUM DEPOSIT

1. Westmoreland
2. Valhalla
3. Maureen
4. Ben Lomond
5. Beverley
6. Honeymoon
7. East Kalkaroo
8. Goulds Dam
9. Lake Way
10. Minindi Creek
11. Bigryli/Walbiri

URANIUM PROSPECT

12. Cloncurry
13. Skal
14. Anderson Lode
15. Mt. Painter
16. Yarramba
17. Mt. Victoria
18. Lake Raeside
19. Manyingee
20. Thatchers Soak
21. Lake Marmion
22. Mt. Joel
23. Pandanus Creek
24. Mt. Bundey
25. AAEC Prospect
26. Barote
27. Beatrice/Caramal

MAJOR URANIUM DEPOSIT

28. Mary Kathleen (Operating Mine & Mill)
29. Yeelirrie
30. Nabarlek (Operating Mill)
31. Jabiluka
32. Ranger (Developing Project)
33. Koongarra
34. Olympic Dam

Figure 1
URANIUM DEPOSITS OF AUSTRALIA

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RAW MATERIALS

4. Property: Ben Lomond
Ownership: Minatome Australia Pty., Ltd.
Ore Reserves: 3,200 tonnes U_3O_8; average grade is 0.30 percent U_3O_8.
Occurrence: Uraninite and coffinite mineralization occurs in Carboniferous volcanics and granites and gneisses.
Current Status: An environmental study is in progress and a mining application has been submitted. Initial production is scheduled for 1985 at an annual rate of about 360 tonnes U_3O_8.

South Australia

5. Property: Beverley
Ownership: Western Uranium Ltd. 50.00%
(subsidiary of Phelps Dodge)
Oilmin NL 16.66%
Petromin NL 16.66%
Transoil NL 16.66%
Ore Reserves: 16,000 tonnes U_3O_8; average grade is 0.28 percent U_3O_8.
Occurrence: Uraninite mineralization occurs in roll-front deposits within paleochannel sand lenses of Eocene and Miocene (Tertiary) age at a depth of 120 meters.
Current Status: An in situ leach pilot plant may be operating in July or August this year; full production of about 1,350 tonnes U_3O_8 is scheduled for 1984.

6. Property: Honeymoon
Ownership: M.I.M. Holdings, Ltd. 49.00%
AAR Ltd. 21.70%
Teton Drilling Co. Pty., Ltd. 12.75%
North Kalgurli Mines Ltd. 12.75%
IOL Petroleum Ltd. 3.8%
Ore Reserves: 3,400 tonnes U_3O_8; average grade is 0.22 percent U_3O_8.
Occurrence: Coffinite mineralization occurs in roll-front deposits associated with paleochannel sands of Eocene and Miocene age.
Current Status: An in situ leach pilot plant is scheduled to be operational by August this year. Annual production could total about 400 tonnes U_3O_8 by 1983 or 1984.

7. Property: East Kalkaroo
Ownership: Carpentaria Exploration Co. Pty., Ltd. 49.00%
ARR Ltd. 21.67%
Teton Drilling Co. Pty., Ltd. 12.75%
North Kalgurli Mines Ltd. 12.75%
IOL Petroleum Ltd. 3.83%
Ore Reserves: 1,100 tonnes U_3O_8; average grade is 0.15 percent U_3O_8.
Occurrence: Coffinite mineralization occurs in roll-front deposits associated with paleochannel sands in the upper Miocene sequence of Tertiary age.
Current Status: Recovery by in situ leaching is being considered.

8. Property: Goulds Dam
Ownership: CSR Ltd. 51.00%
Mines Administration Pty., Ltd. 24.50%
Teton Drilling Co. Pty., Ltd. 12.25%
North Kalgurli Mines Ltd. 12.25%
Ore Reserves: 1,800 tonnes U_3O_8; average grade is 0.12 percent U_3O_8.
Occurrence: Uraninite mineralization occurs in roll-front deposits in paleochannel sands of Eocene and or Miocene age at a depth of about 110 meters.
Current Status: Recovery by in situ leaching is being considered.

Western Australia

9. Property: Lake Way
Ownership: Delhi International Oil Corp. 53.50%
Vam Ltd. 46.50%
(Wyoming Mineral Corp. recently sold its 51 percent interest to Delhi and Vam)
Ore Reserves: 6,400 tonnes U_3O_8; average grade is 0.10 percent U_3O_8.
Occurrence: Carnotite mineralization occurs in calcrete developed along drainage channels entering Lake Way; age is late Tertiary. The deposit is very similar to the larger Yeelirrie deposit.
Current Status: Development and environmental studies are in progress.

10. Property: Minindi Creek
Ownership: Cliffminex NL, Metals & Energy Minerals NL, et al.
Ore Reserves: 1,000 tonnes U_3O_8; average grade is 0.10 percent U_3O_8.
Occurrence: Carnotite mineralization is associated with calcrete along drainage channels.
Current Status: An in situ leach recovery system is planned to produce about 900 kg U_3O_8 per day.

Northern Territory

11. Property: Bigryli Walbiri (Ngalia Basin area)
Ownership: Urangesellschaft mbH & Co. 36.80%
AGIP Nucleare Australia Pty. Ltd. 36.80%
Central Pacific Minerals NL 16.00%
Australian Atomic Energy Comm. (AAEC) 10.40%
Ore Reserves: 2,550 tonnes U_3O_8 in two deposits; weighted average grade is 0.27 percent U_3O_8.

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Occurrence: Carnotite mineralization fills joints and fractures in the faulted and weathered zone of the lower unit of the Mount Eclipse Sandstone of Carboniferous age. Uraninite is the main ore mineral in the deeper unoxidized zones of the prospect.

Current Status: Activity limited to the maintenance of exploration licenses.

Other Prospects

For every uranium deposit discovered, there follows numerous prospects to be evaluated. Some prospects are quickly determined to have little or no economic potential; the more favorable prospects require considerable evaluation. Presently there are many prospects being evaluated throughout the known uranium districts of Australia.

The economic potential of a prospect will be influenced by various factors including: total minable pounds and U_3O_8 content of the ore; recovery costs; geographic location; development strategy and the U_3O_8 supply/demand situation. The rate and extent of evaluation per prospect is often influenced by the same factors. A few Australian prospects that indicate favorable potential and are in various stages of evaluation include: the Cloncurry, Skal and Anderson Lode, all located 15 to 40 Km to the northeast of the Mary Kathleen deposit in Queensland; the Mt. Painter, Yarramba, and Mt. Victoria located in South Australia's Lake Frome and vicinity; Lake Raeside, Manyingee, Thatchers Soak, Lake Marmion and Mt. Joel, located primarily in the vast calcrete environment of Western Australia; and the Pandanus Creek, Mt. Bundey, the AAEC Prospect, the Barote Prospect and the Beatrice Caramal area are located in the Northern Territory. (See Figure 1 for location of each prospect.)

Olympic Dam Project

The discovery of uranium-bearing sulfide mineralization at the Olympic Dam Prospect in the area of Roxby Downs Station near Andamooka, South Australia is perhaps the most significant mineral evaluation project at this time in Australia. The results of exploration indicate the existence of at least two extremely large ore deposits occuring in brecciated volcanics and granite. The deposits contain up to four percent copper and up to 1.75 pounds of uranium; gold is an important accessory mineral. Evaluation work is continuing with 12 drill rigs. In addition, a 500 meter vertical shaft is being sunk at Olympic Dam to permit detailed evaluation of the mineral zone and to obtain large-volume samples for metallurgical testing. The project is controlled by Western Mining Corp. (51 percent) and British Petroleum Co. Ltd. (49 percent).

Unofficially, ore reserves of the prospect are estimated to be in excess of 300,000,000 tonnes. Contained uranium is approximately 300,000 tonnes U_3O_8. The production of uranium will be associated to copper production, therefore, the supply of uranium from the deposits will be dependent upon the supply demand situation for copper rather than uranium. Plans to develop the deposits are indefinite at this time, pending results of further exploration. The prospect area is classified as a major ore deposit and is designated as number 34 on Figure 1.

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STATISTICAL DATA

EXCHANGE VALUE—$25.00/lb U_3O_8
Determined as of April 30, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.

B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of April 30, 1981

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
25.70	2.9	11	6

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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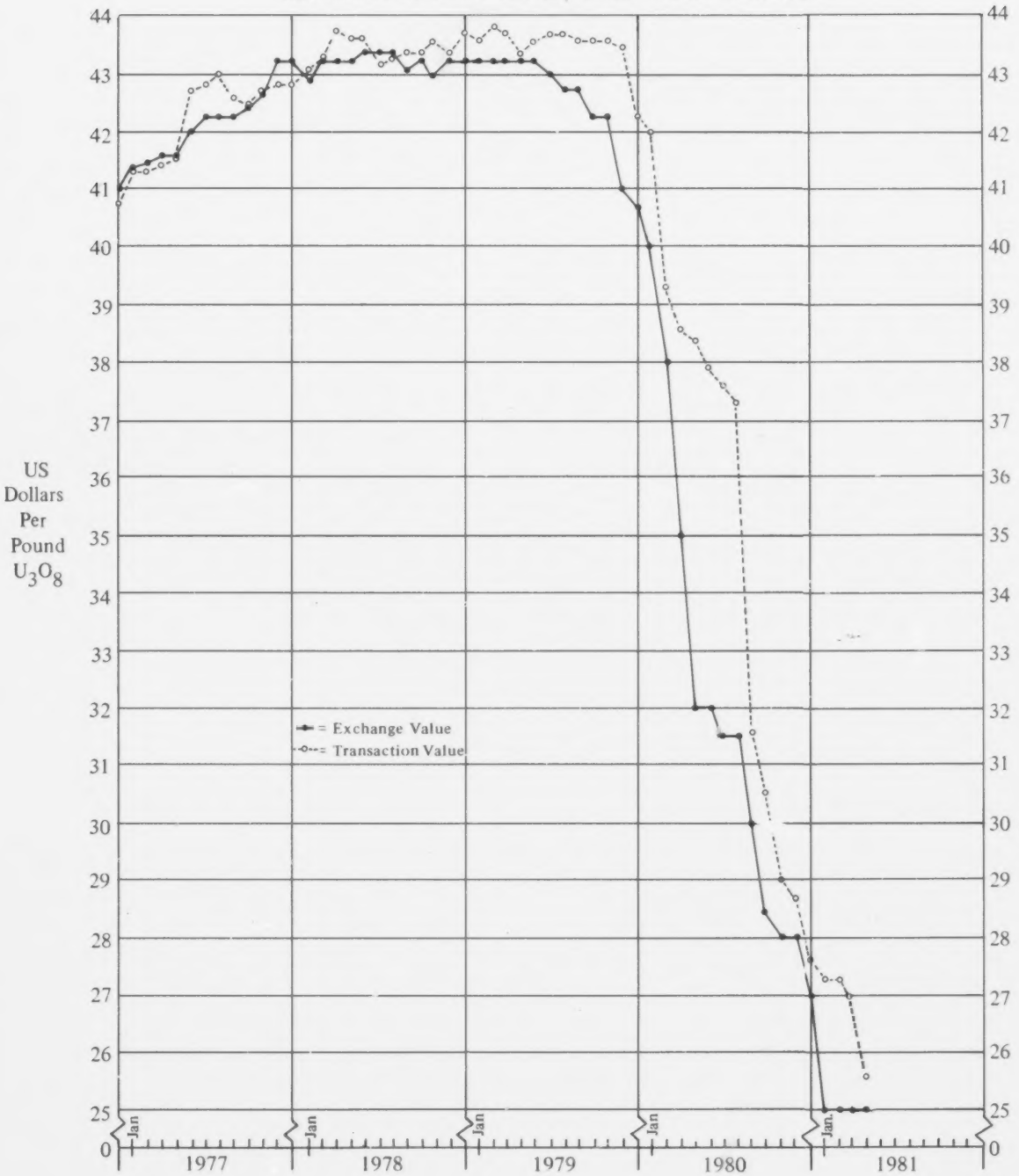
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES
SINCE JANUARY 1977
Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00								

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70								

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	25.00	55.12	64.99
France (franc)	130.82	288.40	340.09
FRG (mark)	55.15	121.58	143.37
Japan (yen)	5,360	11,817	13,935
Switzerland (franc)	50.38	111.06	130.96
UK (pound)	11.63	25.63	30.22
Australia (dollar)	21.70	47.84	56.41
Canada (dollar)	29.91	65.94	77.75
Niger, Gabon (CFA)	6,541	14,420	17,005
South Africa (rand)	20.36	44.88	52.92

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

LOAN USE CHARGE RATE—7.0%/year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

CONVERSION VALUE—$1.40/lb. U as UF_6
Determined as of April 30, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and/or near term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1479	82–96	6001–10000	–	Australia	Europe	Price related to market
1486	81–82	301–600	96	US	US	
1487	81	Less than 50	92	US	US	
1489	81–82	101–300	100	US	US	
1497	81–83	601–1000	99	US	US	
1498	81	Less than 50		US	US	Definitive price information unknown
Conversion Transactions						
1491	82–83	601–1000	113	US	US	
1496	81	101–300	96	US	US	

*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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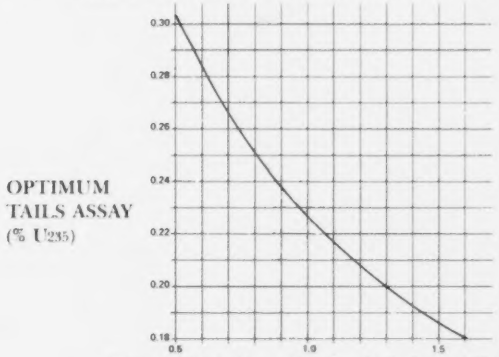
STATISTICAL DATA

OPTIMUM TAILS ASSAY

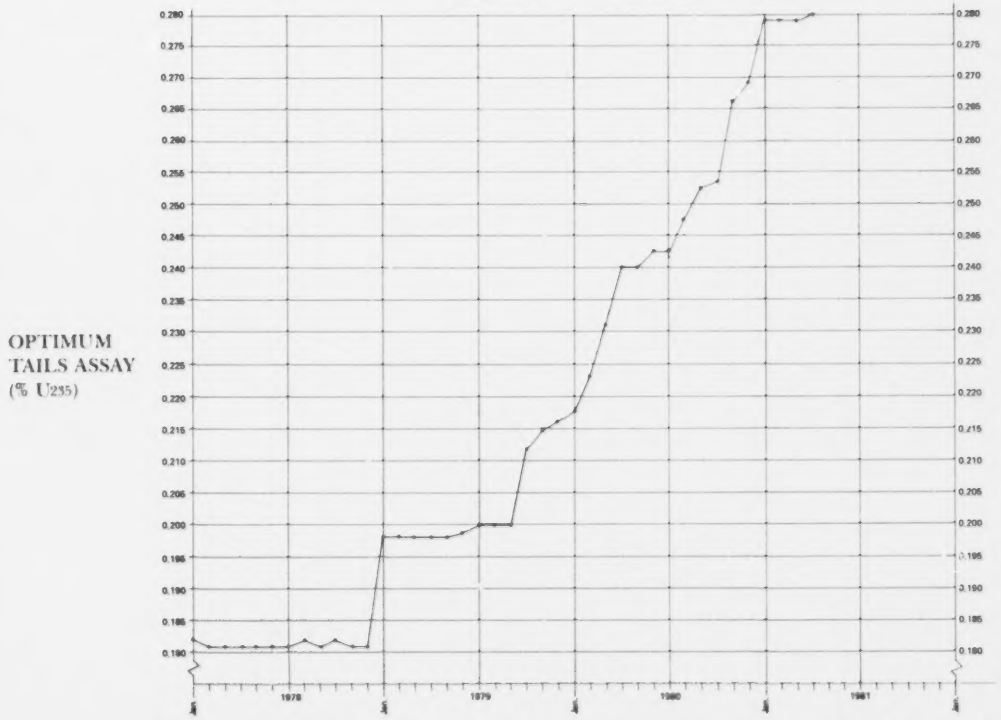
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1]Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]		
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)
Annual Avg. 1970[5]	110.0	116.3	91.36	3.88	3.87	3.69
Annual Avg. 1971[5]	114.1	121.3	96.02	4.12	4.15	3.97
Annual Avg. 1972[5]	117.9	125.3	100.00	4.56	4.59	4.26
Annual Avg. 1973[5]	125.9	133.1	105.80	4.84	4.98	4.51
Annual Avg. 1974[5]	153.8	147.7	116.02	5.44	5.63	4.88
Annual Avg. 1975[5]	171.5	161.2	127.15	6.13	6.24	5.39
Annual Avg. 1976[5]	182.4	170.5	133.71	6.76	6.87	5.91
Annual Avg. 1977[6]	195.1	181.5	141.70	7.28	7.67	6.43
Annual Avg. 1978[6]	209.4	195.4	152.05	8.23	8.56	7.02
Annual Avg. 1979[6]	236.5	217.4	165.46	9.27	9.49	7.60
Annual Avg. 1980	–	246.8	177.36	10.26	10.61	8.29
Jan 1980	260.6	233.2	–	9.91	10.06	7.97
Feb 1980	265.9	236.4	–	9.92	10.01	8.01
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05
Apr 1980	271.3	242.5	–	10.00	10.30	8.12
May 1980	271.9	244.9	–	10.18	10.37	8.17
Jun 1980	273.5	247.6	178.93	10.13	10.69	8.24
Jul 1980	276.2	247.8	–	10.24	10.82	8.35
Aug 1980	278.2	249.4	–	10.38	10.78	8.39
Sep 1980	278.8	251.7	182.92	10.54	10.94	8.46
Oct 1980	281.2	253.9	–	10.58	11.00	8.52
Nov 1980	283.4	256.2R	–	10.73	11.06	8.59
Dec 1980	286.1P	258.4	183.98	10.86	11.31	8.68
Jan 1981	289.9P	260.5	–	10.93	11.30	8.72
Feb 1981	294.8P	263.2	–	11.08P	11.35P	8.77P
Mar 1981	298.9P	265.1P	187.30	–	–	8.80P

P = Preliminary R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Data for 1970-1976, monthly except for the GNP Implicit Price Deflator, and Price Index data for 1977-1978 appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Employment and Earnings data for 1977-1979, monthly, appear on page 33 of Nuexco Report 147.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	215.4	190.04
Annual Avg. 1979	248.8R	196.34
Annual Avg. 1980	321.7P	217.83P
Oct 1979	309.4	201.71
Nov 1979	310.4	201.05
Dec 1979	319.4	201.87R
Jan 1980	340.1	215.74R
Feb 1980	345.6	215.20R
Mar 1980	340.3	214.83R
Apr 1980	327.9	215.14R
May 1980	335.1	214.81R
Jun 1980	338.4	214.14R
Jul 1980	349.1	221.44R
Aug 1980	353.2	219.95R
Sep 1980	351.6	219.45R
Oct 1980	349.5	220.73R
Nov 1980	351.7	221.10
Dec 1980	353.0P	221.43
Jan 1981	359.1P	228.30P
Feb 1981	–	228.12P

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.
(2) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.
(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Annual Avg. 1980	247.0	–	–	–
Nov 1979	228.1	9.97	7.61	7.91
Dec 1979	230.4	9.93	7.51	7.89
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.4R	10.58	8.14	8.65
Sep 1980	252.0	11.00R	8.24	8.71
Oct 1980	255.9R	11.29R	8.28	8.82
Nov 1980	257.6R	11.42R	8.38	8.77
Dec 1980	258.2R	11.43	8.32	8.92
Jan 1981	262.5	11.58P	8.46P	8.90P
Feb 1981	262.6P	–	–	–

P = Preliminary R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.
(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.
(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.
(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Wholesale Price Index All Groups (1975 = 100)
Annual Avg. 1970[3]	7.34	100.3[4]	
Annual Avg. 1971[3]	7.88	106.4[4]	59.1
Annual Avg. 1972[3]	8.79	113.3[4]	63.9
Annual Avg. 1973[3]	10.51	124.1[4]	72.3
Annual Avg. 1974[3]	13.18	138.5[4]	85.3
Annual Avg. 1975[3]	16.71	157.2[4]	100.0
Annual Avg. 1976[3]	19.30	174.7[4]	115.1
Annual Avg. 1977[3]	23.87	194.4[4]	130.0
Annual Avg. 1978[3]	27.14	137.2	142.7
Annual Avg. 1979[3]	30.18	155.3	164.5
Annual Avg. 1980	35.53	176.7	192.1
Jan 1980	–	165.4	178.3
Feb 1980	–	167.0	180.5
Mar 1980	33.65	168.0	181.7
Apr 1980	–	170.0	184.2
May 1980	–	171.9	187.0
Jun 1980	34.48	174.6	189.0
Jul 1980	–	177.2	192.7
Aug 1980	–	179.2	196.8
Sep 1980	36.19	182.8	199.8
Oct 1980	–	186.3	203.1
Nov 1980	–	187.8	205.6
Dec 1980	37.69	189.9	206.5
Jan 1981	–	191.0	207.2
Feb 1981	–	193.8	209.8
Mar 1981	–	195.2	–

(1) Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.
(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."
(3) Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Nuexco Report 140.
(4) April 1970 = 100.00.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
Available for Sale:				
1392	400			
1393	60	175	175	Long term
1475	1000			UF_6
1480	300	300	300	
1490	1250			
1550	250	950		
1552	600			
1562			150	Long term
1575		500	500	Long term
1576	250			
1581	100	150	150	Long term
1595	600	600	800	
1600			200	Long term
1610	50			
1627	1000			
1630	500			UF_6
1637	500	500		
1664	100			
TOTALS	7060	3175	3275	
Available for Loan:				
1429	400			UF_6
1602	400			
1668	300			
TOTALS	1100			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
Inquiries to Purchase:				
1423	1000	1000		
1459			200	Long term
1462			100	Long term
1514	400			
1529			550	Long term
1587		275	275	Long term
1603		100	100	Long term
1634		400	400	
1640	150			
TOTALS	1550	1775	1625	
Inquiries to Borrow:				
1621	300			
TOTAL	300			

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1451	75			
1584	200	200	200	
1607	850	900	1000	
1609	1000	900	1000	
1619		200	100	
1620	125			
1661		400	400	
TOTALS	2250	2600	2700	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1594		400	950	Long term
1608	125	175	175	Long term
1614		300	300	Long term
1622			400	Long term
1626	75			
1665		50	50	Long term
TOTALS	200	925	2075	

***Measured from the date of this Report.**

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 153

The **Exchange Value** remained at $25.00 per pound U_3O_8 for the fourth consecutive month. A few transactions did close below this level, perhaps indicating a softening of the market. However, one large transaction closed at Exchange Value and a much larger percentage of available material continues to be discussed and negotiated at around current Exchange Value.

Active inquiries to sell in the spot and near term market remained at a high level, totaling approximately seven million pounds U_3O_8. Total of inquiries to purchase in the spot and near term market decreased somewhat to 1.5 million pounds U_3O_8. The available near term material is being offered half by primary producers and half by holders of inventory.

The **Transaction Value** declined to $25.70 per pound U_3O_8 from last month's level of $27.00. Transactions from 1981 account for approximately two-thirds of the material used in calculating this month's value. Six uranium transactions are reported this month. Five of the transactions together involved slightly less than two million pounds U_3O_8 for spot and near term delivery. The sixth transaction concerned a resale of Australian material by European equity owners for deliveries over the next fifteen years.

The secondary market for conversion services maintained its high level of activity during April. The **Conversion Value** increased to $1.40 per pound U as UF_6 from last month's level of $1.20. This increase occurred in spite of a tremendous supply overhang in the spot and near term. Two transactions for conversion services in the secondary market closed at around Conversion Value.

European handling of spent fuel, waste storage and reprocessing is summarized in this month's Report. There are two *Topical Essays* this month. One continues the discussion of world demand versus Apparent Future Consumption with a look at the non-US picture. The other presents a study of Japan's nuclear growth and the official optimistic forecast.

Australia's lesser known deposits are summarized and discussed in this month's *Raw Materials* essay.

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JUNE 1981 NUMBER 154

Monthly Report on the Uranium Market

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MONTHLY REPORT ON THE URANIUM MARKET

June 1981 No. 154

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FOREWORD

Beginning with this Report, we will publish an additional US Government index: Gross Average Hourly Earnings of Production or Non-supervisory Workers for Electric and Electronic Equipment (SIC 36). The 1970 to 1979 monthly data for this index is included for reference this month.

There were two typographical errors in last month's Report, Number 153.

United Nuclear Corp.'s (UNC) original interest in the UNC-Homestake Partners operation was incorrectly listed as 40 percent in last month's Report. UNC originally owned 70 percent of the operation.

The Vaal Reefs decrease in profits from uranium in the most recent quarter was incorrectly listed as 19 percent in last month's Report. The South African producer actually reported a 79 percent decrease.

Nuexco President Bob Wolcott delivered a speech at the General Electric 1981 Executive Fuel Conference. A copy of his remarks is included as an insert to the Report.

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URANIUM MARKET

AFRICA

South Africa's uranium resources have been reassessed along the lines of the classification system proposed by the International Atomic Energy Agency. The results of the reclassification are as follows:

Table 1

REPUBLIC OF SOUTH AFRICA
URANIUM RESOURCES AS OF JANUARY 1981
(thousands of metric tons U)

Rock Type	A	B	C	D	E	F	G
Quartz-pebble Conglomerate	206	55	261	81	80	161	422
Tailings	35	9	44	2	5	7	51
Karoo Strata	3	44	47	1	6	7	54
Younger Surficial Sediments	—	1	1	—	—	—	1
Carbonatite	3	—	3	—	—	—	3
TOTAL	247	109	356	84	91	175	531

A: recoverable at a cost of less than US$80/kg U (US$30/lb U_3O_8)
B: recoverable at a cost of US$80—130/kg U (US$30—50/lb U_3O_8)
C: total RAR recoverable at a cost of less than US$130/kg U (US$50/lb U_3O_8)
A, B and C are reasonably assured resources (RAR) (tons U)
D: recoverable at a cost of less than US$80/kg U (US$30/lb U_3O_8)
E: recoverable at a cost of US$80—130/kg U (US$30—50/lb U_3O_8)
F: total EAR recoverable at a cost of less than US$130/kg U (US$50/lb U_3O_8)
G: recoverable at a cost of less than US$130/kg U (US$50/lb U_3O_8)
D, E and F are estimated additional resources (EAR) (tons U)
G is total RAR plus EAR.

It should be noted that the cost categories refer to production costs and not to required selling price. Also, the values are in terms of metric tons uranium metal (U) rather than uranium oxide (U_3O_8). The figures take mining and metallurgical losses into account.

The total amount of uranium resources in the less than US$130 per kg U cost category has increased by only 1,000 tons since the beginning of 1979. Escalating costs are at the root of this minimal change because although the resources have increased, they now come under a cost category greater than US$130 per kg U.

During 1980, the amount spent on uranium exploration in South Africa by 26 mining companies totaled 21.5 million Rand (US$25.4 million). The state itself spent 577,000 Rand (US$680,000) on airborne radiometric and magnetic surveys which covered a total of 67,000 square kilometers. 1980 uranium production figures from 19 plants receiving material from 21 mines showed a 28 percent increase over 1979 production and a 55 percent increase over 1978 production. The 1980 total is 6,146 metric tons U compared to 4,797 metric tons U in 1979 and 3,961 metric tons U in 1978.

The recently released Rio Tinto-Zinc Corp., Ltd. (RTZ) annual report presented a 1980 summary of the Rossing Uranium Ltd. operations, of which RTZ has a 46.5 percent interest. 1980 production of uranium oxide increased to 5,250 short tons U_3O_8 from 4,980 the previous year, in part due to improved efficiency in mining, milling and leaching rates, in addition to enhanced recoveries. Although 1980 costs grew somewhat in comparison to the 1979 number, net profit was significantly higher. 1980 showed a slightly higher sales volume along with higher realized uranium prices.

AUSTRALIA

The contract between Energy Resources of Australia (ERA) and the Swedish utility, OKG, was approved by the Australian Government during May.

The fifth round of safeguards negotiations with Japan will begin next month. Agreement on the text was not reached during the April meeting, although it is expected that the upcoming round of discussion will produce a consensus on the matter. There is reason to believe that the Japanese negotiators will be in no particular hurry to conclude the negotiations in light of Japan's strong uranium supply position and a desire to obtain better terms.

Australia's safeguards agreement with Euratom, initialled at the end of March, is presently going through the various approval stages in Europe and is expected to be finalized without further delay.

Pancontinental Mining Ltd. has announced that its production capacity for the Jabiluka Plant will now be set at 4,500 tons U_3O_8 per year. The original plan was to develop the project in three stages with successive capacities of 3,000 tons, 4,500 tons and finally 9,000 tons per year. The present plan also omits structural and other provisions for an expanded plant beyond the 4,500 tons capacity.

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The plant at Nabarlek has been producing at design capacity despite the strike of operating personnel, which is now running in its seventh week. The plant has been operating with staff labor. Uranium shipments continue to be hindered, but there are some hopeful signs of resolution in the near future.

The South Australian government has approved the Environmental Impact Statement (EIS) of the Honeymoon project. Approval from the federal government is expected shortly. Following this, construction will begin on the pilot plant. Annual output is anticipated to be 100 tons U_3O_8. It is possible that expansion to a full production level of 430 tons will take place by mid-1982.

CANADA

Negotiations between Consolidated Canadian Faraday and AGIP Nucleare S.p.A. to establish the price of production from the Madawaska mine during the June 1, 1981 to December 31, 1982 period have been completed. The price will be Canadian $32.75 (equivalent to US $27.22). Under the new pricing structure, production from Madawaska should be assured through 1982. Operations are expected to be marginally profitable.

Although Northern Saskatchewan has received the majority of exploration interest during the past few years, work has continued in other parts of Canada. One area of interest is Vaughan Hants County, Nova Scotia where Aquitaine Canada has drilled 115 holes to shallow depths on a uranium prospect. The prospect has geologic similarities to uranium occurrences in the central Massif region of France. The project's location on the eastern seaboard could be a marketing advantage, but extensive additional drilling is needed to determine the level of its commercial viability.

EUROPE

Sweden is now relying primarily on nuclear and hydro power for electricity generation. Figures from the first quarter of 1981 show about 36 percent of electricity production coming from nuclear power. The exact percentage from nuclear power will vary with the season and the availability of hydro power. The nuclear percentage is expected to range from 35 to 40 percent over the next few years.

There are a small number of oil fired cogeneration facilities producing electric power in Sweden and peak power is provided at times from oil fired units. Discussions on possible construction of coal fired units are continuing but no such project is under way as yet.

Uranium exploration and mining projects in Portugal will now be open to private sector participation. This shift from a state-monopolized industry will allow private companies to invest up to 49 percent in a mining joint venture with the state-owned National Uranium Company (EUN), as well as allow them to pursue projects on their own.

Portugal's uranium production plans include a four-fold increase over the current annual level of 120 tons by 1985. The country's reasonably assured resources are approximately 9,000 tons U_3O_8.

There have been announcements over the past few months of several European nuclear reactors having reached full power operation. On March 30, 1981, the Spanish 930 MWe Pressurized Water Reactor (PWR) Almaraz nuclear plant achieved its first criticality. The plant's output was first connected to the Spanish grid on April 29. The Italian 840 MWe, Boiling Water Reactor (BWR) Caorso plant reached its first commercial full power operation on March 30, 1981.

The USSR's Leningrad station reported that its fourth 1,000 MWe unit reached full power and was placed on the grid on February 9, 1981. With 4,000 MWe power generation capability, the Leningrad station is now the largest in the USSR. The first three 1,000 MWe units were placed into full power operation on December 1, 1974, December 1, 1975 and June 28, 1980, respectively.

FAR EAST

Recently released data indicates the extent of Japan's diverse uranium supply. Nearly 384 million pounds U_3O_8 have either been delivered or are to be delivered under contracts extending as far into the future as 2003. The country by country breakdown is shown in Table 2 as of December 31, 1980.

The total of 383.9 million pounds under contract as of the end of 1980 represents an increase of some 32 million pounds U_3O_8 from year end 1979. Australia

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Table 2

URANIUM SUPPLY COMMITMENTS TO JAPAN

Supplier Country	Millions of Pounds U_3O_8	Percent of Total Supply	Last Delivery Year of Longest Term Contract
Canada	121.7	31.7	2003
England	87.0	22.7	1996
South Africa	58.5	15.2	1994
France	23.0	6.0	1986
Australia	37.4	9.7	1996
US	16.0	4.2	1991
Niger	40.3	10.5	1996
TOTAL	383.9	100.0%	

and Canada account for this additional material by supplying 21 million pounds and eight million pounds respectively.

The material designated as England-supplied is primarily from Rio Tinto-Zinc Corp. Ltd. (RTZ). The sources of this supply are Australia, Canada and Namibia. In the case of France the countries of origin include, in addition to France, Niger, Gabon and perhaps Canada and South Africa.

These data reveal several interesting points. South Africa's 15 percent share of Japan's supply is approximately equal to South Africa's traditional 16 percent share of world uranium production. Although Australia is presently shown representing only ten percent of Japan's total supply, it is expected that this share will increase in the future in view of the historic raw materials trade between these two countries. Finally the US, despite being the world's largest uranium producer, has had only a small share of the Japanese market.

UNITED STATES

Legislation reducing the amount of uranium severance tax in New Mexico was passed by that state's legislature a few months ago. The bill which passed was a modified version of an original one which called for a reduction of the tax by basing it on only 25 percent of sales price. The final form of the bill imposes a severance tax on 60 percent of sales price and has a three year sunset clause. Thus the schedule of uranium severance taxes passed in New Mexico in early 1980 has in effect been reduced by 40 percent.

On May 6, 1981, the US Department of Energy (USDOE) published increases in the price of separative work, as follows:

1. *Requirements-type Contracts:* Effective 180 days after publication, the price for separative work under Requirements-type contracts will be $141.15 per SWU, or the ceiling charge, whichever is less.

2. *Fixed-Commitment Contracts:* Effective October 1, 1981, price for separative work under all Fixed-Commitment contracts will be $130.75 per SWU.

The USDOE has released figures which show nuclear energy ahead of oil in electricity generation for 1980. The 251.1 billion kilowatt hours of electricity (11 percent of all power generated) produced by nuclear power, barely edged oil's contribution of 246 billion kilowatt-hours (10.8 percent of US electricity). This represents the first time in US history that nuclear power has led oil in electricity generation. Although nuclear production declined 1.6 percent from 1979 figures, oil generation fell approximately 19 percent. A 1.7 percent increase was seen in overall electrical generation.

Now that the entire Westinghouse affair appears to be reaching an end, the market implications of the litigation and settlements can be examined. Following are some conclusions on how the Westinghouse situation will effect uranium supply, demand and price.

Table 3 summarizes Nuexco's estimate of the uranium involved in the utility settlements with Westinghouse. The original court-ordered allocations are included in the totals. In three of the settlements (Duquesne Lighting Co., Southern Ser-

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URANIUM MARKET

vices Co., and the Tennessee Valley Authority), there was no additional uranium involved other than the original allocations. Table 4 summarizes Westinghouse's total annual delivery obligations under the settlements.

As a result of the settlements, Westinghouse is now in a position to fill all of its litigated uranium supply commitments. Table 5 shows the latest Nuexco estimate of Westinghouse's cumulative supply-demand balance. Westinghouse commitments to deliver uranium to the former utility litigants total 30.2 million pounds U_3O_8 between 1981 and 1999. Inventory, material already under contract and supplies from settlements of Westinghouse suits against producers will yield a total of 25.8 million pounds during the period. The balance of 4.4 million pounds U_3O_8 remains to be filled, either by additional purchases, or by Westinghouse production from Wyoming Mineral Corp. That obligation would be reduced to 3.4 million pounds if Long Island Lighting Co. does not exercise its option to purchase. This material balance concerns only the utility contracts formerly under litigation, and not any other supply commitments Westinghouse may have. However it would appear that Westinghouse has brought its uranium supply position to the point where it should not have a significant influence on the market.

Table 3

ESTIMATED QUANTITIES OF URANIUM INVOLVED IN WESTINGHOUSE SETTLEMENTS
(thousands of pounds U_3O_8)

Utility	Quantity Originally in Dispute[1]	Settlement Quantity[1,2]
Consolidated Edison Co.	2,500	2,200
Duquesne Lighting (Capco)	700	100[3]
Florida Power & Light Co.	3,600	1,700
Kansas Gas & Electric Co.	4,000	2,400
Long Island Lighting Co.	9,000	2,600[4]
Northeast Utilities	2,700	2,000
South Carolina Electric & Gas Co.	4,000	2,400
South Texas Project	10,500	8,700
Southern Services Co.	800	100[3]
Sweden: Sydkraft		
SSPB	5,000	3,800
OKG		
Tennessee Valley Authority	3,600	600[3]
Texas Utilities	2,900	1,200
Union Electric Corp.	10,200	6,200
Virginia Electric & Power Co.	13,800	9,900
Wisconsin Electric Power Co.	2,600	1,900
TOTAL	75,900	45,800[5]

[1]Quantities are rounded to nearest 100,000 pound.
[2]Including original court-ordered allocation.
[3]No uranium other than original court-ordered allocation was included in the settlement.
[4]Includes an option for one million pounds on the part of Long Island Lighting Co.
[5]Difference between this total and that of Table 4 is due to rounding.

Table 4

ESTIMATED TOTAL ANNUAL DELIVERIES UNDER WESTINGHOUSE SETTLEMENTS
(thousands of pounds U_3O_8)

Year	Quantity	Year	Quantity
1976	5,000	1986	2,600
1977	2,300	1987	2,600
1978	2,200	1988	2,600
1979	2,300	1989	2,400
1980	3,600	1990	1,900
1981	2,000	1991	2,000
1982	2,100	1992	1,500
1983	1,500	1993	1,200
1984	1,800	1994	1,200
1985	2,100	1995-99	2,300
		TOTAL	45,200

Table 5

NUEXCO ESTIMATE OF WESTINGHOUSE CUMULATIVE SUPPLY-DEMAND BALANCE
(1981-1999)
(millions of pounds U_3O_8)

Total Delivery Commitments Including Settlements	30.2
Available Supplies (other than future production)	
Inventory	1.7
Purchases	1.6
Gulf Settlement	13.0
Foreign Producer Group Settlement	9.0
Other	0.5
	25.8
Unfilled Commitments	4.4

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URANIUM MARKET

TRANSACTIONS

There are three uranium transactions reported this month. One is a spot sale of between 50 and 100 thousand pounds U_3O_8 equivalent as UF_6 from a US producer to a US utility. A small spot sale of less than 50 thousand pounds U_3O_8 was made from a US producer to a European utility. A larger transaction of between 300 and 600 thousand pounds U_3O_8 took place between a US utility and a European utility. The delivery period is 1982.

One secondary market conversion transaction is reported this month. It involves the conversion of between 50 and 100 thousand pounds U.

PRICING

The **Exchange Value** as of May 31, 1981 is $25.00 per pound U_3O_8, unchanged from the four previous months. The major factors considered in the determination of this month's Exchange Value were:

1. Two near term transactions closed at the $25.00 level involving a total of about 500,000 pounds U_3O_8 or its equivalent.

2. Sellers are responding at about the $25.00 level to open requests for material and are countering at this level to bids made at under Exchange Value.

3. Some active US sellers have withdrawn their material from the market in order to respond to a non-US inquiry. Due to the validity conditions of these offers, the material is no longer available for sale to other parties.

4. US producers looking for available material are renewing their contacts with inventory holders. Earlier, such inquiries preceded the announcement of shutdowns, as well as increased demand for replacement U_3O_8.

Material available for near term delivery as presented in the *Market Opportunities* section totals 7.7 million pounds U_3O_8 or its equivalent. Over one fourth of the available material is in the form of UF_6 which must be either swapped or deconverted in order to respond to requests for U_3O_8. Inquiries to purchase U_3O_8 total 1.75 million pounds for the same period.

The **Transaction Value** remained at $25.70 per pound U_3O_8 for the second consecutive month. Qualifying transactions numbered 12 and involved 2.9 million pounds U_3O_8 sold over the last seven months.

CONVERSION

The **Conversion Value** declined 25 cents to $1.15 per pound U as UF_6. This decrease in the spot and near term market price for conversion services, following an increase in the previous month, demonstrates the volatility of a thin market, particularly as one side of the market clears.

A number of inventory holders unable to sell UF_6 are attempting to deconvert their material so they may sell it as U_3O_8. However, the needs of most buyers desiring conversion services for spot or near term delivery have recently been covered and the lack of new buyer interest has exerted downward pressure on the price. U_3O_8 inventory holders may emerge as buyers in this secondary market if the price becomes such that it argues for storage of material in a more advanced form.

In addition, the primary converters have been more aggressive in the terms and conditions they are offering, particularly in the longer term, responding to secondary market competition. Because price differential is the main reason for buyers to look to the secondary market, the secondary market price is under pressure from the activities of the primary converters.

One transaction for conversion services in the secondary market is reported this month involving between 51 and 100 thousand pounds U of conversion for immediate delivery. The price is higher than current Conversion Value.

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TOPICAL ESSAY

WORLD DEMAND: PART III, OBSERVATIONS

In Reports 151 and 153 Nuexco presented breakdowns of its estimate of US and non-US demand. The methodology used to develop these demand figures was briefly explained, and the difference between demand and Nuexco's Apparent Future Consumption (AFC) was clarified. In this essay the two previous commentaries are combined to provide a worldwide peiture, and some general conclusions are drawn.

To review, AFC is Nuexco's computation of the amount of U_3O_8s which would be required to fabricate fuel for loading and reloading reactors. It is compiled and computed on a reactor by reactor basis, with AFC for each reactor being based on specific core characteristics, 0.25 percent tails assay, no recycling, 24 month lead times for first core procurement and 18 month lead times for reload procurement. Reloads are assumed to occur one year after the commercial operating date and annually thereafter except in cases where alternate schedules are known to be used by individual utilities. Nuexco estimates of individual capacity factors are used.

Demand, of which AFC is a significant component, includes the intangible market perceptions of each utility. Factors such as price, security of supply, political actions and inventory situations influence each buyer's view of the market. Each utility has quantified these perceptions into a set of demand figures, and Nuexco has compiled these utility numbers into an aggregate form.

Tables 6 through 9 show Nuexco's estimate of Utility Demand, Utility Demand Less AFC, Unfilled Demand, and Unsold Production for the World (Outside Communist Areas). Theoretically, total demand will always be greater than or equal to AFC. The further out the estimate is made, the larger the difference between demand and AFC is likely to be. Conversely, the demand estimate will approximate AFC as the length of time forecast becomes shorter.

Thus, in Table 7 the annual difference between demand and AFC is steadily increasing over time. This reflects the fact that as utilities are forced to forecast their demand farther into the future, their demand estimates become increasingly conservative relative to the actual requirements of the reactor. However, the difference between demand and AFC is not uniformly increasing over time, and it is here that reality differs from theory. In actuality, utilities do not purchase along AFC lines but along anticipated demand lines, and this is further skewed by official reactor schedule changes, cancellations, and supply shifts. Consequently, there are many situations in which demand has in effect appeared and been filled one or more years before AFC shows it.

It is even possible that, for a given utility in a given year, AFC will exceed demand. An example of this would be a utility which had originally planned to have a reactor come on line in 1980, and therefore purchased uranium for the first core in 1978, but subsequently slipped the commercial operation date to 1984. In this case the first core AFC would appear in 1982, but there would be no demand component, as this demand had already been filled. Thus the 1982 AFC figure would probably be higher than the 1982 demand figure. It is for this reason that Table 7 has a *non*-uniformly increasing difference.

Table 8 goes on to show World Utility Unfilled Demand, which may be compared against Table 9, World Unsold Production. As can be seen, the cumulative unsold production through 1990 exceeds the cumulative unfilled demand. In assessing the world unsold production, Nuexco has done so on a mill by mill basis. Some of the largest planned uranium operations have been assumed to be cancelled or deferred and their output is not in the unsold production category. Despite this relatively low production estimate, on a cumulative basis unsold production still exceeds the utilities unfilled demand, which must be considered to be a high case of actual utility needs. Thus it would appear that upward pressure on real uranium prices would not be expected for some time.

The above conclusion assumes that free market economics apply. Specifically, it assumes the non-occurrence of a US uranium embargo, of an interruption in supply due to political reasons or of any effective government price controls in major exporting countries. It is in these areas that uncertainty remains, and if there is to be any marked change in price, it is likely to come as a result of these activities.

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TOPICAL ESSAY

Table 6

WORLD UTILITY DEMAND
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	8.0	12.4	13.7	16.2	18.2	21.0	20.9	22.3	22.1	22.5
Europe	32.3	39.5	39.6	44.9	42.8	46.8	51.2	48.0	49.1	49.0
Other WOCA	4.0	5.3	6.5	6.3	7.0	7.4	8.7	8.6	7.9	9.1
US	36.6	37.3	42.4	48.3	52.9	55.9	55.9	56.9	57.5	57.3
World Total:	80.9	94.5	102.2	115.7	120.9	131.1	136.7	135.8	136.6	137.9
Cumulative:	81	175	278	393	514	645	782	918	1,054	1,192

Table 7

WORLD UTILITY DEMAND LESS AFC
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	1.1	5.5	6.9	5.1	6.5	9.4	10.2	12.7	13.6	13.8
Europe	6.7	10.6	4.2	14.1	6.5	8.8	6.3	5.6	5.8	6.3
Other WOCA	0.9	0.2	0.6	1.2	2.4	1.5	1.2	1.6	2.3	3.0
US	15.7	14.4	15.3	17.9	20.1	20.4	20.8	19.3	17.1	17.0
World Total:	24.4	30.7	27.0	38.3	35.5	40.1	38.5	39.3	38.8	40.
Cumulative:	24	55	82	120	156	196	235	274	313	353

Table 8

WORLD UTILITY UNFILLED DEMAND
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	0.0	0.1	0.1	0.1	0.3	1.8	1.3	4.3	3.4	6.4
Europe	1.5	1.7	3.3	3.7	3.9	5.5	5.7	6.9	8.4	7.4
Other WOCA	0.4	0.7	1.8	1.6	2.3	1.6	1.9	2.6	1.9	2.2
US	0.3	1.5	4.4	6.4	12.3	14.9	23.8	28.9	33.6	36.3
World Total:	2.2	4.0	9.6	11.8	18.8	23.8	32.7	42.7	47.3	52.3.
Cumulative:	2	6	16	28	46	70	103	146	193	245

Table 9

WORLD UNSOLD PRODUCTION
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual:	16.8	16.8	17.5	22.4	25.1	32.9	35.8	37.3	40.2	39.6
Cumulative:	17	34	51	74	99	132	167	205	245	284

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COMMENTARY

The Evolving Uranium Market

Today's uranium market is markedly different from that of just two years ago. This section will enumerate some of those changes and touch on the reasons for their occurrence. Of course, the most important change is price. That of the Exchange Value published on May 31, 1979 was the last one to attain the all-time high level of $43.25; two years later, Exchange Value has declined by 40 percent. If inflation is taken into account, today's Exchange Value is less than half that of two years ago. The most important reasons for the decline are outlined below:

1. Forecasts of installed nuclear electric generating capacity have been reduced repeatedly, as have the associated forecasts of reactor uranium requirements. The accident at Three Mile Island (TMI) is largely responsible for stimulating worldwide reassessments of nuclear power. As a result of those reassessments, numerous reactor plants have been cancelled, deferred or delayed.

2. Rising prices for electrical energy have depressed demand. Projections of high growth rates for electric demand have given way to substantially lower projections. In the US, expected growth rates have dropped from seven percent per annum a few years ago to approximately two percent per annum. Even though regional exceptions may exist, the average US surplus of generating capacity has increased more than 30 percent.

3. Reaction to the accident at Three Mile Island led to a US moratorium on licensing of power reactors. That moratorium and the additional safety retrofits imposed in response to TMI set back the US nuclear industry by more than two years, even though the moratorium itself lasted less than half that time. Over the past two years, the number of new US nuclear power plants estimated to begin commercial operation has changed drastically. Before TMI, Nuexco estimated that 61 plants would begin commercial operation in the US during the period 1979 through 1984. Six months after TMI, the number had dropped to 50. Last November Nuexco estimated that 21 plants would start up during that time period. Today, in light of recent US NRC statements there are only 17 in that category.

4. Changes in the US Nuclear Regulatory Commission (NRC) licensing procedures have led forecasters to adopt more pessimistic attitudes toward the future rate of additions to US nuclear electric generating capacity. The USNRC itself has come to be widely recognized as an obstacle to the licensing of power reactors.

5. The general financial health of US utilities has worsened and awareness of this problem has increased. Double-digit inflation, soaring interest rates, construction cost overruns, construction delays and licensing delays have combined to increase dramatically the difficulty of financing the construction of power reactors. Record amounts of money must now be financed for longer periods of time at higher interest rates. Under these conditions, it is doubtful that any US utility would seriously consider ordering a new nuclear plant.

6. Utilities find it more and more difficult to fund construction, especially that of power reactors. Consumers find it increasingly difficult to pay in advance for benefits which may or may not be realized at some indeterminate future time. Rate-making bodies, being essentially political animals, respond much more to the near term desire to keep rates down than to the prospect of running short of electricity after their terms of office expire.

7. Adherents of the so-called soft energy paths advocate an energy strategy based on wind, tides, geothermal steam, biomass fuel, solar energy and conservation. Despite the lack of sufficient technical or economic development, the advocates of such a strategy give short-sighted regulators a convenient excuse for ignoring the realities of their energy future.

8. Ever since the advent of commercial nuclear power, uranium production has exceeded consumption. The past two years have seen the widespread recognition of the degree of this imbalance. This recognition has depressed near-term demand for uranium.

9. Utilities have begun selling some of their large uranium inventories. This added selling pressure has exacerbated the market imbalance created by high inventories, low demand and overproduction.

10. As uranium prices have dropped, the economics of uranium production have changed quite rapidly. US producers having high production costs have entered the market to buy material rather than produce it.

11. Several US producers have cut back, suspended or terminated all or portions of their uranium

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COMMENTARY

production operations in response to expectations of a prolonged price depression.

Thus the uranium industry has quickly reached a condition of depression not seen since the early 1970's. It would be interesting to compare the state of the industry today with the earlier depression. The Exchange Value has remained at $25 for 5 months. Many have asked if this is a signal that the market has bottomed out. The US market price bottomed at about $6 per pound in 1972. Using the Implicit Gross National Product (GNP) deflator as an inflation index, $6 in 1972 is roughly equivalent to $11.22 today. (The most recent index is 187.30, compared to the 1972 annual average of 100.0)

To get a true comparison of relative economics, it is necessary to include changes in cost due to factors other than inflation. The grade of ore is generally the most sensitive variable in cost of production in the mining industry. If the 1972 price is further adjusted to the change in grade between 1972 and today, a more accurate comparison can be made between today's Exchange Value and the price reached at the bottom of the previous depression. US average ore grade in 1972 was 0.21 percent U_3O_8 versus 0.12 percent in 1980.

Thus the $6 price in 1972 could be roughly equated to a price of about $20 today. ($6 x 187.3/100 x 0.21/0.12) However, there have been additional cost increases since 1972 occasioned by health, safety and environmental legislation, and increased severance taxes. General industry opinion is that these increased costs have amounted to on the order of five dollars per pound in the US.

In conclusion it could be argued that today's spot market price is economically equivalent to the price at which the previous depression bottomed out. This does not necessarily indicate the market has bottomed out; only that any further significant decline might lead to a more seriously depressed market than that of the early 1970's.

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RAW MATERIALS

GREAT DIVIDE BASIN, WYOMING

The newest uranium production center in the US is located in the Red Desert area of the Great Divide Basin, Wyoming. Union Oil Co. of California began production operations at its Sweetwater Uranium Project in October 1980. Production was interrupted by a fire in the mill in late October and was not resumed until February of this year. Since then, it has been demonstrated that the production facility is capable of operating at design capacity of 3000 tons ore per day. Figures 1 and 2 are aerial photographs of the open pit mine and mill of Union Oil's Sweetwater Uranium Project. Tailings will be deposited in the large holding area at the top of each figure.

Union Oil is one of about 30 to 35 companies which was attracted to the Great Divide Basin for uranium exploration during the early 1970's. The renewed potential for discovering uranium in basin Tertiary rocks followed discoveries in Tertiary formations of the mountainous areas to the north and northeast of the basin (Crooks Gap and Green Mountains area). Subsequent exploration in the Red Desert led to a number of uranium discoveries associated with many miles of identifiable roll-front geology.

It appeared by the mid 1970's that the new district would become a major production center. However the fluctuation of the uranium concentrate market has resulted in postponements and or cancellations of a number of scheduled production projects. The Union Oil project may be the only conventional mine and mill complex to achieve production in the district prior to the emergence of more favorable market conditions. Another factor which undoubtedly led to the postponement of certain projects is the characteristically low-grade nature of mineralization in the basin area. Overall, the average uranium content of ore is about one pound U_3O_8 per ton, although there are a few isolated high-grade zones containing limited tonnage.

District Geology

The Great Divide Basin is a structural depression encompassing over 3500 square miles in Sweetwater and Fremont Counties of central Wyoming. The entire basin area is confined within a segment of mountainous topography along the Continental Divide. This unusual topographic feature was created by a divergence of the Continental Divide at the northwest and southeast limits of the basin and caused the area to become captive to internal drainage, erosion and redeposition.

Geologically, the Great Divide Basin consists of a number of internal basins. The Red Desert is by far the largest single depression, occupying almost the entire central and eastern portion of the basin area. It is presently considered to be the most important area for the occurrence of uranium; however, important deposits occur in Bison Basin as well. Discoveries outside the Red Desert and Bison Basin areas have been small and of limited potential for commercial development.

Geologic development of the basin began during Late Cretaceous and continued through much of early Eocene time. Essentially all exposed rocks within the basin consist of lacustrine and fluviatile sediments of Tertiary age. The basin is surrounded by older rocks positioned along the Continental Divide during the period of uplifting and faulting. The source of most Tertiary sediments was from the north and northeast. Rocks of Precambrian through Cenozoic age were highly faulted and folded to make up Crooks Mountain and the Green Mountains immediately adjacent to the basin area and the Granite Mountains further to the north.

The oldest Tertiary formation present in the basin is the Fort Union Formation which is deposited unconformably on the Lance Formation of Late Cretaceous age. The Fort Union consists mostly of lacustrine shale, siltstone and thin sandstone associated locally with impure coal beds. The source of arkosic sandstones and conglomerates distributed throughout the northern portion of the Fort Union deposition was probably the Granite Mountains. The age of the Fort Union Formation is Paleocene.

The Fort Union Formation is overlain by sediments of Eocene age which make up about 4000 feet of basin fill. The western and southern portions of the basin are covered by the Wasatch group which includes the Green River and Bridger Formations. The Wasatch group consists of sandstone, siltstone, limestone, conglomerates, oil shale and coal beds. To the north and northeast, the Wasatch group rapidly grades into and intertongues with the equally thick, medium to very coarse grained arkosic sandstones and conglomerates of the Battle Spring Formation. The entire formation consists of fluvial stream deposition.

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Figure 1
AERIAL VIEW OF THE OPEN-PIT MINE AT UNION OIL'S SWEETWATER URANIUM PROJECT, RED DESERT AREA, WYOMING

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Figure 2
AERIAL VIEW OF THE MILL AND TAILINGS DISPOSAL AREA AT UNION OIL'S SWEETWATER URANIUM PROJECT, RED DESERT AREA, WYOMING. ORE STOCKPILE IS AT LEFT.

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The general nature of the make up and mode of occurrence of the Battle Spring Formation indicates that its source was predominantly from the Granite Mountains to the north. During the late Paleocene and throughout the early Eocene times, extremely large quantities of debris were eroded from the Granite Mountains to form a vast coalescing alluvial fan complex which spread southward into the basin. Additional coarse material was deposited basinward during the period of uplifting of Crooks Mountain and the Green Mountains. The poorly sorted material making up the formation contains detrital coal and carbonaceous trash which combines to make the formation a suitable host for uranium deposits. The major uranium deposits of the basin are confined to the Battle Spring Formation.

Uranium Deposits

Uranium was first discovered in the Great Divide Basin in 1936. Schroeckingerite, a hydrated fluocarbonate-sulfate of sodium, calcium and uranium was discovered at Lost Creek in the Red Desert. Although the occurrence is considered to be the largest known deposit of schroeckingerite in the world, it represents a limited quantity of low-grade uraniferous material. The existence of the mineralization drew attention to the basin area and resulted in prospecting during the mid-1940's. Anomalous radioactivity was subsequently discovered in coal beds located in the central basin area about 1945.

Prospecting throughout the region gained momentum in the early 1950's following important discoveries in the Gas Hills district. The prospecting spread rapidly into the Crooks Mountain, Green Mountains and Red Desert areas after commercial uranium deposits were found in the Crooks Gap district in 1954. By the end of 1972, about 6.8 million feet of drilling had been completed in the Red Desert area. Interest in the area increased again as a result of exploration success during the early 1970's. Through the end of 1980, exploration and development drilling exceeded 18 million feet in the Red Desert and Bison Basin areas.

At least 28 important low-grade uranium deposits have been discovered in the basin area, mostly in the Red Desert. In addition, numerous occurrences of mineralization have been discovered but have not yet been fully delineated. The mineralization is almost always associated with poorly-sorted, arkosic sediments of the Battle Spring Formation. The ore occurs in C-shaped and tabular deposits, both associated with typical roll-front geology as related to multiple alteration frontal systems that extend basinward in extremely sinuous patterns. The ore deposits may occur in at least four sandstone horizons as is the case at Union Oil's Sweetwater project.

The greatest amount of ore is found in a single sandstone unit about 150 feet thick. The remaining ore-bearing sandstone units vary from about five to 50 feet in thickness. A large number of the basin ore deposits are within 200 to 400 feet of the surface and are suitable for open pit or solution mining. Nuexco roughly estimates low-grade reserves for the basin area to be about 100 million pounds U_3O_8. Figure 3 shows the approximate location of the ore deposits and roll-front trends with relation to area geology. However, five of the ore deposits shown on the map are actually within the Crooks Gap district; reserves of these five deposits exceed 150 million pounds U_3O_8. Table 10 identifies ownership of the various ore deposits shown on the map.

Table 10

OWNERSHIP OF URANIUM DEPOSITS IN THE CENTRAL AND NORTHEAST PORTIONS OF THE GREAT DIVIDE BASIN, WYOMING

Crooks Gap District	Red Desert and Bison Basin Districts
1. Western Nuclear, Inc.	4. Texasgulf, Inc.
2. Pathfinder Mines Corp. (Big Eagle Mine)	5. Kerr McGee Corp.
3. The Anaconda Co. Pioneer Nuclear, Inc. Texas Eastern Nuclear, Inc.	6. Pioneer Nuclear Texas Eastern
	7. Teton Nedco
	8. Union Carbide Corp.
	9. Union Oil
	10. Ogle Petroleum
	11. Rocky Mountain Energy Co.
	12. Conoco, Inc.

Uranium Source

The source of uranium in the Red Desert area was probably the uranium-rich granites from the Granite Mountains and the volcanic tuffs that covered most of the region from about middle Eocene time. Uranium was taken into solution as the groundwater moved through the uranium-bearing formations. It precipitated-out in the favorable environment of the Battle Spring Formation. The main ore mineral

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present in the district is uraninite. Coffinite has been identified as an accessory mineral in several different ore deposits.

Formation porosity and permeability is important to the stability of ore zones. The coarse-grained and coalescing nature of the Battle Spring Formation created a hydrologic environment conducive to rapid discharge and recharge of mineral-bearing solutions. The rapid movement of solutions through the formation dispersed the uranium among the thick sandstone units as well as among the coal and shale beds. The result was a wide distribution of low-grade uranium mineralization scattered throughout the district.

Such conditions have also been a factor in establishing a disequilibrium between uranium and its daughter products, a condition which is apparent in certain areas. Disequilibrium is rather common in mineralization situated above the present water table or within an oxidized ore zone. The radiometric values in a disequilibrium are often noticeably higher than the actual value of contained U_3O_8. The reverse of this is true in certain circumstances with ore below the water table, or in that portion of an oxidized zone situated on the permanent water table; the chemical values are higher than the radiometric values. This type of "enrichment" tends to support the theory that down-dip migration of uranium has taken place. One may expect to discover "high-grade" mineralization by exploring the uranium-bearing formation to greater depths.

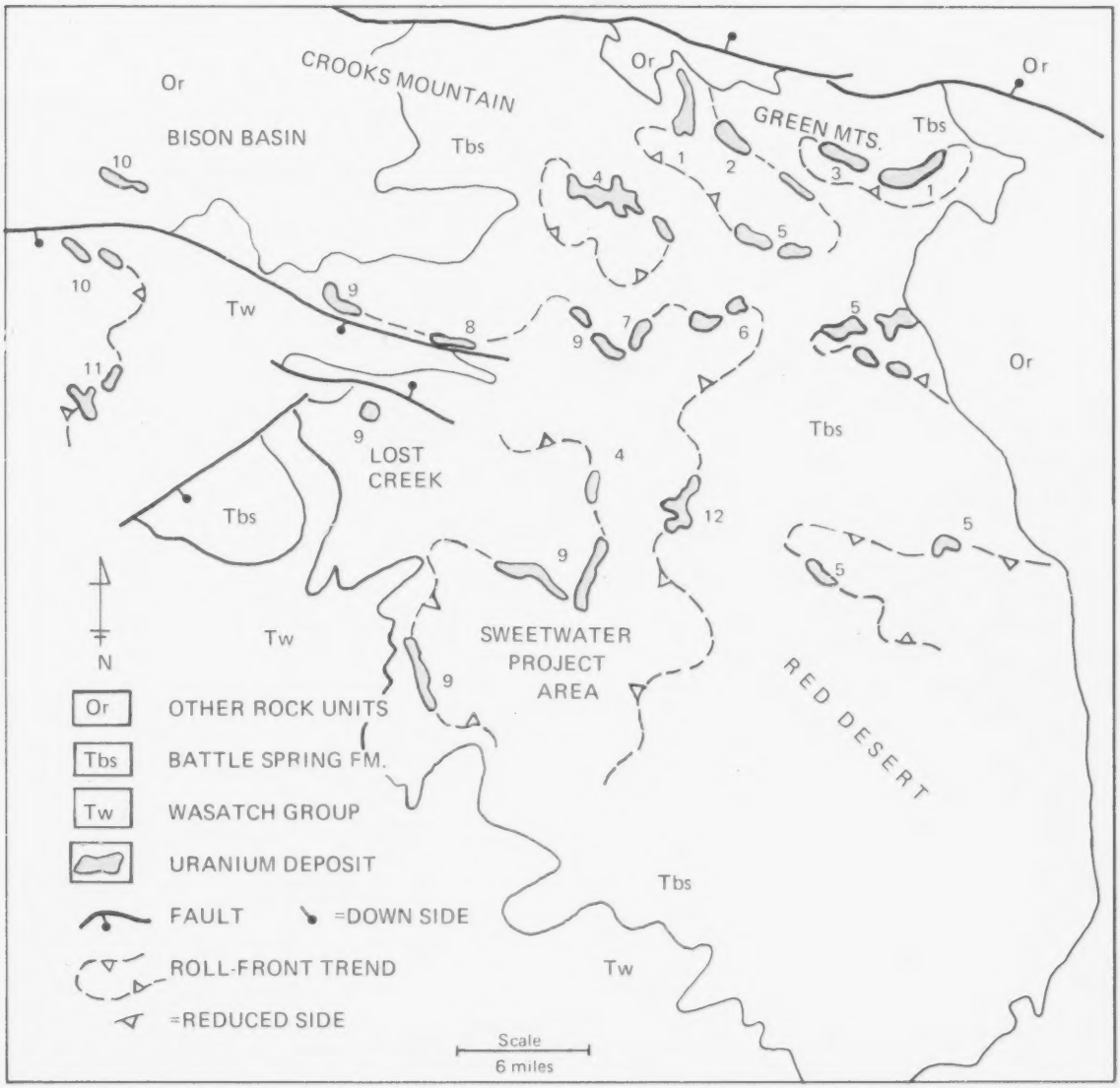

Figure 3
GEOLOGIC MAP OF THE NORTHEAST PORTION OF THE GREAT DIVIDE BASIN, WYOMING SHOWING LOCATION OF URANIUM DEPOSITS AND ROLL-FRONT TRENDS. NUMBERS IDENTIFY OWNERSHIP OF ORE DEPOSITS (SEE TABLE 10)

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STATISTICAL DATA

EXCHANGE VALUE—$25.00/lb U_3O_8
Determined as of May 31, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.

B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of May 31, 1981

$ /lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
25.70	2.9	12	7

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES
SINCE JANUARY 1977
Determined as of the last day of the month indicated

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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00							

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70							

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	25.00	55.11	64.99
France (franc)	137.89	304.00	358.49
FRG (mark)	58.07	128.02	150.97
Japan (yen)	5,598	12,341	14,553
Switzerland (franc)	51.97	114.58	135.12
UK (pound)	12.08	26.63	31.40
Australia (dollar)	21.94	48.38	57.06
Canada (dollar)	30.02	66.19	78.06
Niger, Gabon (CFA)	6,895	15,200	17,925
South Africa (rand)	21.20	46.74	55.12

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

LOAN USE CHARGE RATE—7.0%/year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

CONVERSION VALUE—$1.15 lb. U as UF_6
Determined as of May 31, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and or near term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1502	81	51–100	92	US	Europe	
1516	81	51–100	100	US	US	UF_6
1517	82	301–600	100	US	Europe	UF_6
Conversion Transactions						
1514	81	51–100	122	US	US	

*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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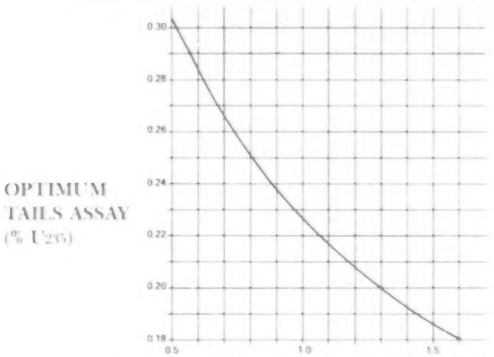
STATISTICAL DATA

OPTIMUM TAILS ASSAY

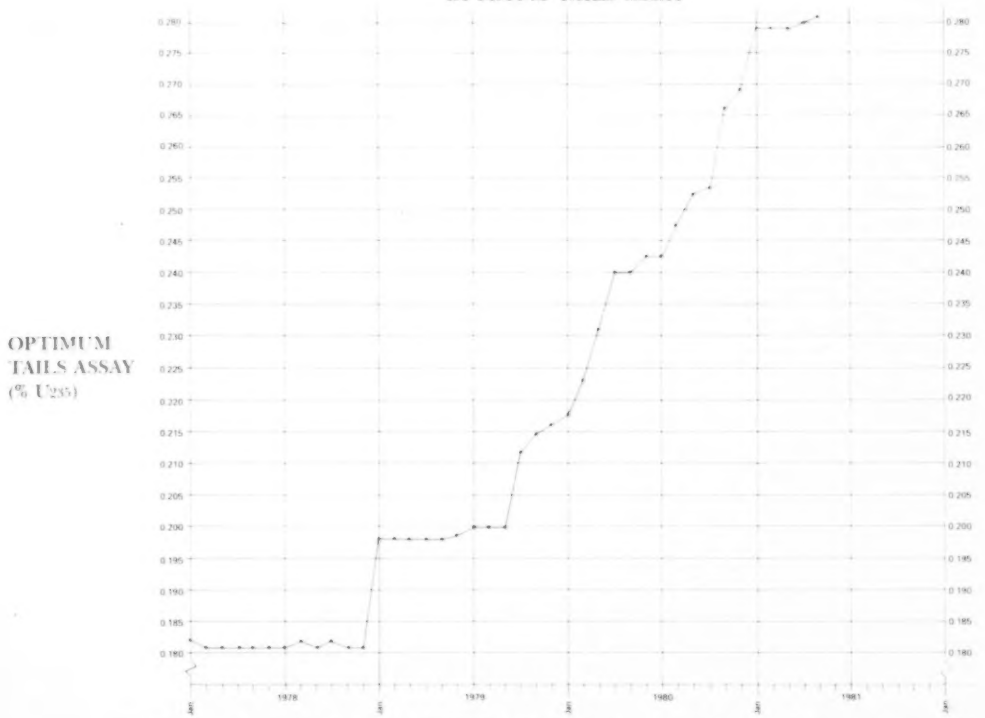
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1]Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
Ann. Avg. 1970[5][7]	110.0	116.3	91.36	3.88	3.87	3.69	3.28
Ann. Avg. 1971[5][7]	114.1	121.3	96.02	4.12	4.15	3.97	3.49
Ann. Avg. 1972[5][7]	117.9	125.3	100.00	4.56	4.59	4.26	3.71
Ann. Avg. 1973[5][7]	125.9	133.1	105.80	4.84	4.98	4.51	3.91
Ann. Avg. 1974[5][7]	153.8	147.7	116.02	5.44	5.63	4.88	4.21
Ann. Avg. 1975[5][7]	171.5	161.2	127.15	6.13	6.24	5.39	4.64
Ann. Avg. 1976[5][7]	182.4	170.5	133.71	6.76	6.87	5.91	4.96
Ann. Avg. 1977[5][6][7]	195.1	181.5	141.70	7.28	7.67	6.43	5.39
Ann. Avg. 1978[5][6][7]	209.4	195.4	152.05	8.23	8.56	7.02	5.82
Ann. Avg. 1979[6][7]	236.5	217.4	165.46	9.27	9.49	7.60	6.32
Ann. Avg. 1980	–	246.8	177.36	10.26	10.61	8.29	6.96
Jan 1980	260.6	233.2	–	9.91	10.06	7.97	6.67
Feb 1980	265.9	236.4	–	9.92	10.01	8.01	6.71
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05	6.78
Apr 1980	271.3	242.5	–	10.00	10.30	8.12	6.79
May 1980	271.9	244.9	–	10.18	10.37	8.17	6.78
Jun 1980	273.5	247.6	178.93	10.13	10.69	8.24	6.87
Jul 1980	276.2	247.8	–	10.24	10.82	8.35	6.96
Aug 1980	278.2	249.4	–	10.38	10.78	8.39	7.02
Sep 1980	278.8	251.7	182.92	10.54	10.94	8.46	7.14
Oct 1980	282.2	253.9	–	10.58	11.00	8.52	7.20
Nov 1980	283.4	256.2	–	10.73	11.06	8.59	7.29
Dec 1980	286.6	258.4	183.98	10.86	11.31	8.68	7.39
Jan 1981	289.9	260.5	–	10.93	11.30	8.73R	7.42
Feb 1981	294.8	263.2	–	11.16	11.35	8.79	7.45
Mar 1981	298.9	265.1	187.30	11.13P	11.50P	8.81P	7.49P
Apr 1981	302.8P	266.8P	–	–	–	8.90P	7.53P

P = Preliminary R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Monthly data 1970-1978 for Price Indexes and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Monthly data 1977-1979 for Employment and Earnings SIC codes 10, 333, and 28 appear on page 33 of Nuexco Report 147.

(7) Monthly data 1970-1979 for Employment and Earnings SIC code 36 appear in this report.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[1]
Electric and Electronic Equipment (SIC 36)

Month	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970
Jan	6.12	5.65	5.23	4.81	4.49	4.05	3.83	3.62	3.42	3.17
Feb	6.14	5.67	5.22	4.81	4.50	4.04	3.82	3.64	3.42	3.20
Mar	6.17	5.67	5.24	4.84	4.54	4.06	3.82	3.65	3.45	3.23
Apr	6.12	5.69	5.26	4.80	4.56	4.06	3.85	3.66	3.45	3.24
May	6.22	5.72	5.29	4.86	4.59	4.13	3.86	3.68	3.48	3.26
Jun	6.26	5.74	5.34	4.87	4.64	4.20	3.88	3.69	3.48	3.29
Jul	6.28	5.83	5.39	4.95	4.66	4.22	3.92	3.70	3.50	3.31
Aug	6.37	5.86	5.44	5.00	4.67	4.22	3.95	3.72	3.50	3.30
Sep	6.47	5.94	5.50	5.07	4.73	4.32	3.98	3.76	3.52	3.32
Oct	6.49	5.95	5.51	5.11	4.73	4.37	3.99	3.76	3.52	3.31
Nov	6.52	5.98	5.55	5.13	4.76	4.40	3.99	3.78	3.53	3.33
Dec	6.64	6.10	5.64	5.20	4.83	4.49	4.06	3.83	3.61	3.41
Ann. Avg.	6.32	5.82	5.39	4.96	4.64	4.21	3.91	3.71	3.49	3.28

(1) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970[3]	101.4	59.88
Annual Avg. 1971[3]	101.5	65.95
Annual Avg. 1972[3]	105.6	71.26
Annual Avg. 1973[3]	124.4	78.96
Annual Avg. 1974[3]	141.9	108.07
Annual Avg. 1975[3]	150.4	132.55
Annual Avg. 1976[3]	168.4	160.93
Annual Avg. 1977[3]	192.0	179.03
Annual Avg. 1978[3]	198.5	190.04
Annual Avg. 1979	248.8	196.34
Annual Avg. 1980	321.7	217.83
Jan 1980	340.1	215.74
Feb 1980	345.6	215.20
Mar 1980	340.3	214.83
Apr 1980	327.9	215.14
May 1980	335.1	214.81
Jun 1980	338.4	214.14
Jul 1980	349.1	221.44
Aug 1980	353.2	219.95
Sep 1980	351.6	219.45
Oct 1980	348.7	220.73
Nov 1980	351.0P	221.10
Dec 1980	353.0	221.43
Jan 1981	359.1	228.30
Feb 1981	358.0	228.12
Mar 1981	356.6P	227.34P

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra, "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.
(2) Australian Bureau of Statistics, Canberra, "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.
(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Annual Avg. 1980	247.1R	10.59	8.05	8.50
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.4R	10.58	8.14	8.65
Sep 1980	252.0	10.85R	8.24	8.71
Oct 1980	256.0R	11.05R	8.28	8.82
Nov 1980	257.7R	11.11R	8.38	8.77
Dec 1980	258.3R	11.13R	8.32	8.92
Jan 1981	262.8R	11.27P	8.51P	8.90P
Feb 1981	263.2	11.43P	8.61P	9.00P
Mar 1981	264.6P	—	—	—

P = Preliminary R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.
(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.
(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.
(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Wholesale Price Index All Groups (1975 = 100)
Annual Avg. 1970[3]	7.34	100.3[4]	
Annual Avg. 1971[3]	7.88	106.4[4]	59.1
Annual Avg. 1972[3]	8.79	113.3[4]	63.9
Annual Avg. 1973[3]	10.51	124.1[4]	72.3
Annual Avg. 1974[3]	13.18	138.5[4]	85.3
Annual Avg. 1975[3]	16.71	157.2[4]	100.0
Annual Avg. 1976[3]	19.30	174.7[4]	115.1
Annual Avg. 1977[3]	23.87	194.4[4]	130.0
Annual Avg. 1978[3]	27.14	137.2	142.7
Annual Avg. 1979[3]	30.18	155.3	164.5
Annual Avg. 1980	35.53	176.7	192.1
Jan 1980	–	165.4	178.3
Feb 1980	–	167.0	180.5
Mar 1980	33.65	168.0	181.7
Apr 1980	–	170.0	184.2
May 1980	–	171.9	187.0
Jun 1980	34.48	174.6	189.0
Jul 1980	–	177.2	192.7
Aug 1980	–	179.2	196.8
Sep 1980	36.19	182.8	199.8
Oct 1980	–	186.3	203.1
Nov 1980	–	187.8	205.6
Dec 1980	37.69	189.9	206.5
Jan 1981	–	191.0	207.2
Feb 1981	–	193.8	209.8
Mar 1981	–	195.2	209.9
Apr 1981	–	196.4	–

(1) Chamber of Mines of South Africa, Johannesburg, "Analysis of Working Results," published quarterly.
(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."
(3) Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Nuexco Report 140.
(4) April 1970 = 100.00.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
Available for Sale:				
1392	400			
1393			175	Long term
1475	1000			UF_6
1480	200	300	300	
1490	1250			
1540	200	750		UF_6
1550	1000			
1562			150	Long term
1575		500	500	Long term
1576	250			
1581	100	150	150	Long term
1595	600	600	800	
1600			200	Long term
1627	1000			
1630	500			UF_6
1637	500	500		
1664	100			
1678		275		
1681	500			UF_6
1685	100			
TOTAL	7700	3075	2275	
Available for Loan:				
1429	400			UF_6
1602	400			
1671	300			
TOTAL	1100			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
Inquiries to Purchase:				
1052	600			
1423	1000	1000		
1459			200	Long term
1462			100	Long term
1514		400		
1529			550	Long term
1587		275	275	Long term
1603		100	100	Long term
1634		400	400	
1670	100			UF_6
1674	50			
TOTAL	1750	2175	1625	
Inquiries to Borrow:				
1621	300			
1687	200			
TOTAL	500			

**Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco' Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1451	75			
1584	200	200	200	Long term
1607		1000	1000	
1609	1000	900	1000	
1619		200	100	
1630	400			
1661		400	400	Long term
1681	400			
TOTAL	2075	2700	2700	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1594		400	950	Long term
1622			400	Long term
1626	75			
TOTAL	75	400	1350	

*Measured from the date of this Report.

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 154

The **Exchange Value** remained at $25.00 per pound U_3O_8, unchanged from four previous months. Sellers are responding at about this level to open requests for material and large quantities of material are still being discussed at about this price. Two near term transactions involving about 500,000 pounds closed at Exchange Value.

Active inquiries to sell in the spot and near term market total 7.7 million pounds U_3O_8. Over one-fourth of the available material is in the form of UF_6.

Inquiries to purchase in the same time period total 1.75 million pounds U_3O_8. About two-thirds of the available near term material is being offered by holders of inventory, the remaining one-third by primary producers. This represents the highest percentage of available material from inventory in quite some time. As in the past, this increased level of inventory holding could exert additional downward pressure on price.

The **Transaction Value** remained at $25.70 per pound U_3O_8 for the second consecutive month. Three near term uranium transactions are reported this month, involving a total of about 500,000 pounds.

The lack of new buyer interest for conversion services in the secondary market is reflected in the **Conversion Value** decline of 25 cents to $1.15 per pound U as UF_6. One transaction for conversion services in the secondary market is reported this month.

The reclassification of South Africa's uranium resources are tabled in this month's Report. This month's Report also looks at the impact of the Westinghouse situation on uranium supply and demand. The *Topical Essay* concludes the discussion of demand versus Apparent Future Consumption with an integration of the previous essays and draws some general conclusions on the world situation.

The Red Desert area of the Great Divide Basin, Wyoming is featured in this month's *Raw Materials* essay.

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COMMENTS OF:

J. R. Wolcott
President
Nuexco

PRESENTED AT:

General Electric 1981 Executive Fuel Conference

May 18, 1981
Hilton Head, South Carolina

Comments of:

J. R. Wolcott
President
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My talk today concerns the challenges of nuclear fuel supply in the 1980's. Most of my comments are related to present conditions, assurance of supply, and market trends. At the end I will describe my estimate of a plausible scenario for the 1985-1990 period.

The whole uranium industry is in the process of change. Even before Three Mile Island (TMI) change was inevitable. But the increased demand anticipated by the supplier industry did not materialize. Now wrenching change is upon the industry through the forces of markets in disequilibrium, mining economics and new ways of utility thinking. More than lack of demand is at work here.

New Versus Old Perceptions

As a starting point, I think it worthwhile to contrast several industry perceptions as they existed four or five years ago with perceptions today. Previous views were that:

1. US uranium producers would have difficulty *expanding* to meet US demand. A world *shortage* was probable.
2. Expansion of Australian and Canadian production was *essential* to avoid shortages in the early 1980's.
3. Uranium *prices* would continue to *rise* as demand exceeded supply.
4. *Enrichment* capacity would become *inadequate*. It was necessary, therefore, to build enriched inventory in the early 1980's for use in the late 1980's. Artificially accelerated expansion of the production was necessary.

Today's perceptions are the reverse:

1. US *production* is far in *excess* of domestic need. The producer industry is in contraction.
2. Canadian and Australian supply is *optional*—not *essential*. Those nations are expanding production mainly through displacement of higher cost production elsewhere in the world and not by filling increased world demand.
3. *Prices* may be essentially *flat* for some time.
4. *Enrichment* capacity is in *excess*.

The Current Situation

Demand for uranium has virtually plateaued at the moment in the US. World demand is growing, but not rapidly. Nuclear programs in most countries have been slowed. By Nuexco estimate, United States requirements will rise from the 1980 level of 21 million pounds U_3O_8 per year, to 40 million pounds by 1990, and world requirements will rise from 57 million to 100 million pounds during the same period. Projects already under way will account for nearly all the increased consumption.

The producer industry has had no difficulty keeping ahead of demand. In fact, US production currently exceeds consumption by a factor of two to one. Why the disparity? The answer lies in the long term nature of past contracts. Some were negotiated when prices were low and a buyer finds it advantageous to continue to require delivery. At worst, profitable resale is possible. Some contracts were negotiated when prices were higher and may currently be at $50 to $60. Thus the seller requires delivery.

Existing contracts are winding up at the same time that US consumption and supply numbers are becoming more even. Production will decline by five million pounds to 37 million pounds this year, to less than 25 million pounds in 1984 and under 20 million pounds by 1985.

Inventories have been increasing. US utilities own approximately 125 million pounds U_3O_8 equivalent. The Government owns an additional 135 million pounds. At current rates of consumption, all operating US plants could operate more than six years using only utility inventories and for 14 years including use of government inventories. An acute shortage of uranium is not a present danger.

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A large sum of money is tied up in inventory maintenance. The utility owned inventory has a value on the order of three billion dollars. Assuming a cost of money of 20 percent, the annual carrying cost is six hundred million dollars. If one were to include government-owned inventories, the cost would almost double.

High production costs and large inventories have led to a spot market in which usual buyer/seller roles have in some cases been reversed. Half the spot transactions in today's market are inventory-holder-to-producer sales. What was once viewed as a price floor, production cost, is now a price *ceiling* because of this role reversal. We have referred to this situation as an "upside down" market.

I have described conditions for which there is no quick fix. Increased demand would normalize conditions but that will require time. Licensing six reactors per year, the maximum feasible according to the Nuclear Regulatory Commission (NRC), would increase consumption only ten percent per year. Industry needs a 100 percent increase now to retain present production levels.

The Role of Policy and Assurance of Supply

We are prone when looking to the future to think of numbers, charts and graphs and to discount policy. Policy is in fact a vital consideration when assessing assurance of supply. How much *risk* one can afford; how much to *allocate* to reducing risk; and how to *distribute* resources, are matters of policy. Quantitative analysis is taken into account but the final judgment is one based on policy.

It is difficult to describe the full range of choices facing the policy maker. One method is to break down the assurance of supply issue into three dimensions: *collective security*, *vertical integration* and *horizontal diversification*.

Assurance of supply in this context means assurance of fuel supply for continuity of operations. Assurance of *fuel* supply and assurance of *uranium* supply are not necessarily the same. Uranium is only one element and conversion, enrichment and fabrication are required before uranium is in a usable form. Decision-making has thus become increasingly sophisticated. I would like to discuss some of the implications of supply assurance with respect to buying, inventories and markets. To do so, I will use the three dimensional system outline above.

Collective Security

"Collective security" encompasses provision for oneself, contribution to security of others and dependence upon others. No utility stands alone; all are interrelated by public interest. The same idea is applicable to different nations.

US utilities and the government, as mentioned, own large inventories. However, this inventory is not evenly dispersed. The advantages of large holdings as compared to small holdings are not wholly clear. We know, especially from Oil Embargo history, that the government allocates in a crisis. A company with ample supplies will be asked to aid those in short supply. How much to own for possible benefit to others, as opposed to oneself, is a difficult planning question.

Vertical Integration

"Vertical integration," refers to the form of fuel inventory. Does one gain by owning one pound of U_3O_8 equivalent as fully fabricated fuel or by owning 50 pounds of reserves? Investment requirements may be the same.

Much of the existing inventory distribution is a result of assumptions which have not held true including the forecasts and perceived conditions at the time of contracting. Thus, plans and operating policies developed in the past are no longer appropriate for today's industry.

The cost considerations of inventory have changed as well. Managing a fuel inventory may be a little like managing a stock portfolio. One needs to consider values of assets and price trends. Five years ago the cost of a SWU was approximately $59; the cost of U_3O_8, $40 per pound; and the cost of UF_6 conversion about $2 per pound of contained uranium. Today those costs are $131 per SWU, $25 for U_3O_8, and $1.40 for conversion (secondary market). The change is an increase of

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221 percent for SWU's; a decrease of 60 percent for U_3O_8; and a decrease of 70 percent for conversion.

The clear winners, from a portfolio perspective, are those who held enriched rather than natural uranium. Furthermore, they had additional security because the fuel was nearer a usable form.

I do not mean to suggest that a fuel manager can, or should, switch fuel from one form to another in the same way that a mutual fund manager might switch stocks. But over the long pull, economics will cause the fuel manager to change mix as circumstances permit.

Users of uranium are also adapting their roles of direct involvement in the fuel side. The number of US utilities active in exploration, mining or milling has dropped from 24 a few years ago, to 10 or 15 today. Quantitative analysis may show that zirconium is the most critical element of the front end of the fuel cycle where only two or three sources are available and where inventories may only be adequate for a few months.

Horizontal Diversification

The third dimension of the assurance of supply issue is "horizontal diversification", the impact of geographic and nationalistic interests. Here, one examines the costs and benefits of purchasing in various amounts from the US, Canada, Australia and Africa. I think it may be worthwhile in this context to comment briefly upon the three major areas, *Canada*, *Australia* and *Africa*, which will be responsible for three-fourths of the 1990 world uranium supply. These sources will have major influence on security of uranium supply.

Africa

Africa currently supplies 40 percent of world production and will provide slightly more by 1990. The supplier nations are South Africa, Namibia (formerly Southwest Africa), Niger and Gabon. South Africa and Namibia account for two-thirds of total African supply.

Africa is a continent of turmoil. Over 20 major wars and 35 government coups have occurred during the past two decades. Eight wars involving 15 nations were in progress a little over a year ago. Twenty-one nations have dictatorial governments and economic conditions are continuing to deteriorate.

One might hastily conclude that Africa is high risk, but that view would not necessarily be shared by Africa's clients, nor would the record support such a conclusion. South Africa for example, is rated as the most reliable of world suppliers by most of its uranium customers. However, South Africa's long term risks are greater than its short term risks. While *internal* security is strong, *external* political support is weak. A disruption in uranium supply in the near or intermediate term appears unlikely but remains a possibility.

Australia

Australia will soon produce 12 million pounds of uranium per year, which is a little over ten percent of the world's total. The leading producers are Mary Kathleen Uranium Ltd., Queensland Mines Ltd. and Energy Resources of Australia, Ltd. Mary Kathleen and Queensland will deplete deposits presently being exploited around 1985. Unless new production is added, Australian production will probably decrease to eight or nine million pounds by 1990.

Australia has enormous potential to be a continuing source of uranium. Reasonably assured reserves exceed one billion pounds and much of the continent remains to be surveyed. Uranium has been found in the widely separated provinces of Queensland, the Northern Territories, Western Australia and South Australia. A vast copper deposit in South Australia, known as Olympic Dam, will make large scale by-product uranium recovery economical. Several companies, including Pancontinental Mining Ltd. and Western Mining Ltd., are poised to proceed when market and government clearances permit.

A slight blemish on Australia's reputation for reliability is of concern to some. Australia began production in the early 1970's under a Liberal Party Government. The Labor Party was subsequently voted into power and terminated uranium development except for existing contracts. The Liberal Party was returned to power in 1976 and resumed the development. The

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Labor Party claims it will again stop production if returned to power. However, this is not a realistic approach given the internally divisive nature of the issue.

The worldwide role of Australia is different than the one anticipated five years ago. Failure to expand production or even curtailment, would not be as severe as was once feared. Other nations could, and would, take up the slack—but again I emphasize that I do not believe it will be necessary.

Canada

Canada currently accounts for approximately 15 percent of the world total uranium supply and will supply 26 million, or more than one-quarter of the world total by 1990.

Canada, like the US, has a blemish on its reliable supplier image. Exports were temporarily halted to some nations while bilateral agreements were renegotiated. As in the case of Australia, I doubt that history will repeat itself. Canada is regarded by US buyers as the most reliable of non-US sources. One US utility places Canadian supply on a par with US supply.

A Summation

My objective in the foregoing discussion was to emphasize the broad range of factors in the fuel supply issue. Funding, decisions on source, risk assessment, geography, political trends and future need are all interrelated. One eventually arrives at the equivalent of a point of balance in the three dimensional model I abstractly constructed. But the point is constantly shifting. The objective is to maintain the position as dictated by policy as opposed to one acquired as a consequence of past circumstances.

As a practical matter, we are probably looking forward to significant shifts in the construction of fuel policy. The more critical uncertainties have shifted from yellowcake supply towards readiness for the reactor-to-use side. A shift of investment towards fabricated fuel and away from mining operations is expected. In short, the optimum for the next decade is not what it was for the past decade.

Market Trends

I would like to move next to market trends. Changes including adjustments by the supplier industry are being forced by price pressure, cost leadership of non-US suppliers, new buyer perceptions and governmental influences.

Changes in Cost Leadership

The US, until recently, was the dominant force in the uranium market, responsible for 40 percent of world uranium production and consumption. The US industry was built around low grade ore. Ore grade is usually the most important factor in production cost because low grade means high cost. Currently, average US production cost is around $30 per pound U_3O_8.

In comparison, recent discoveries outside the US have remarkable ore grades. Saskatchewan has qualities as high as 40 to 60 pounds per ton. That compares with an average US ore grade of approximately 2.5 pounds per ton . Australia has millions of pounds in the six to eight pound per ton range. Some are as high as 47 pounds per ton. Some Australian and Canadian production costs for certain ore bodies are less than ten dollars per pound. Much of the production in Western Canada is profitable at less than $25 per pound.

Price leadership eventually follows cost leadership. A cost leader has the ability to move price up or down. If he moves up, a high cost producer will soon follow. If he moves down, he will probably capture a larger market share. The high cost producer cannot readily lower price. This means that long term prices will be determined outside the US. Prices will remain low long enough to allow economics to dominate while market position is being established. Low cost production will replace high cost production as an economic process. After the transition, the political processes will be of more importance than they are today.

Buyer Contracting Attitudes

Buyers' attitudes today differ from the attitudes five years ago, as one might expect, owing to an abundant uranium supply. An upward price threat of a type requiring a hedge is not foreseen. The situation has encouraged buyers to be more demanding. Buyers often press for long-term

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contracts requiring market price in effect at time of delivery. High cost US producers find it difficult to accept such terms while low-cost producers can assume the reasonable risk of a market-related contract. US buyers are, accordingly, dealing with non-US producers more easily than US producers.

Prospects for an Import Embargo

There are political implications for a US producer industry which is declining from 42 million pounds in 1980 to less than 20 million pounds by 1985. US facilities will be idle as dependency upon non-US sources grows. The issue has outward characteristics similar to the automobile industry.

An important question, of course, is whether an import embargo might help the supplier industry. The answer is that it almost certainly would not. The US industry would need both a two-fold increase in consumption and a doubling of current price to sustain it at current production. The embargo would arrive too late in any case. Production will have cut back to half the current level within four or five years.

An import embargo might aid the US supplier industry in the long term. By *1990* the US will be consuming at a rate nearly equal to *1980* production. However, government utilities and consumers would not willingly support excess production above world prices for ten years.

In light of these and other considerations, I do not expect an effective import embargo. I do expect Congressional consideration. However, the closer the scrutiny, the less likelihood that the embargo will be viewed as a solution to the particular industry problem.

Supplier Governments

Three points are worthy of note concerning world supply and the governments associated with it:

First, supplier and user nations are different. The US is the only important exception. Other uranium producer nations export all, or virtually all, production and thus benefit from a high price.

Second, all major supplier nations exercise government control over export terms including price. Canada requires approval by the Uranium Export Review Board, Australia by the Uranium Export Office and South Africa by the Atomic Energy Board. Niger and Gabon operations are owned or dominated by government.

Third, by the end of the decade, three countries and three governmental bodies will supply over 60 percent of the world supply. All low cost sources are under control of those three.

Ironically, US antitrust laws have helped expand non-US government influence. Antitrust laws do not apply to governments. Government price determination is used when governments favor domestic operations suited to their own domestic conditions while at the same time avoiding infringement of US law. The result has been a centrallizing and tightening of world price control.

The Price Outlook

By 1985 US production will be approximately 20 percent of the world total, down from the present 40 percent. US consumption will remain around 40 percent. The influence of the US competitive producer system will have declined. The dominant influence will have moved elsewhere where competition is viewed differently.

Uranium prices continue to be soft and will remain so while uncommitted production exceeds unfilled requirements. Low cost production can expand given even further price depression. If price is determined purely by *economics*, we will see further price declines, possibly substantial ones. Price declines will lead industry in every country, including the US, to seek government assistance.

Effective actions by governments to increase prices will be difficult as long as overproduction and free market mechanisms are dominant. Neither US nor non-US governments have the capability to do much about price while heavy oversupply and inventory conditions prevail.

Once US consumption exceeds US production, establishing a dependency upon imports, non-US government price determination will be a more effective tool. This may take five years as US production will not drop below US consumption until 1983 or 1984.

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Even when government controls do become more influential, a *rapid* jump in prices is not likely. The US lacks only low cost production capability. A too rapid price rise by non-US producers would bring back a viable US industry.

A reasonable guess as to future prices by 1990 would be a low of $30 per pound in future dollars, a high of $50 per pound and a midpoint of $40 per pound U_3O_8. The numbers assume a seven percent rate of inflation. In terms of constant dollars, the price would be a low of $22 per pound, a high of $34 per pound and a midpoint of $26 per pound U_3O_8.

Hypothesized 1985 to 1990 Scenario

If I were a US buyer in need of a 1985 to 1990 picture, I would construct the following scenario. Here I emphasize a mild distinction between *predicting* and *hypothesizing*. I am providing the latter, or what I view as the most plausible set of circumstances taken as a whole. The total scenario in each individual instance will not, most certainly, be realized.

1. Uranium will be abundant well beyond this decade.

2. The price in 1985 will be close to the present level in *constant* dollars. Strong price competition will continue for several years.

3. Major supplier nations' governments will have a growing interest in mechanisms to produce higher prices. Whereas present priorities are first, market share, and second, price, future priorities will reverse and place *price* first and *market share* second.

4. Natural uranium inventories will decline. Most inventories will move toward a zero to two years' supply level with about a 12 month supply level as the goal.

5. Towards the end of the decade, more than half of the US supply will come from non-US sources. Canada, Australia and Africa will be the dominant sources and Canada will be the most favored by US buyers.

6. Utilities will be less involved in exploration, mining and milling. The prior driving forces of price and assurance of supply will remain low.

7. Resources allocated to enhance assurance of supply will be shifted more towards fabricated fuel and less towards natural uranium.

8. Fuel management will be increasingly sophisticated. Techniques, such as operational analysis, will optimize inventory and minimize risks associated with assurance of supply.

9. Enrichment and conversion capacity will be more than ample.

10. Uranium will be purchased more on the spot market and less by long term contracting. Some successful buyers, as now, will rely wholly upon the spot market.

11. World uranium reserves will be adequate. No urgent pressure will be applied to develop alternate technologies because of potential uranium shortages.

12. The US supplier industry will consist of about half the present number of suppliers. All types of recovery, conventional mining, phosphoric, heap leaching, and solution mining, will experience cutbacks. Phosphoric will be the least affected (because of long term contracts). Conventional mining and milling will be the most affected.

13. Increased consumption will continue in France, Japan, Korea and Taiwan.

14. New plant orders during the 1980's will not impact significantly upon the uranium market.

On the whole, the near term outlook is for a competitive, sluggish, over-supplied market. Political forces, if effective, may alter conditions some after the mid-1980's.

Most of you are probably readers of the cartoon strip, "Peanuts." A main character, Charlie Brown, is well known for his philosophic twists. One of his more notable lines is "No problem is so big and so complex that it can't be run away from."

Charlie Brown never met nuclear power. I have described today a fuel industry in difficult straits. The nuclear power industry to which it supplies has large and complex problems. Even so, I remain a long term optimist. I don't think we can "run away" from nuclear power.

On the other hand, I do not believe that major changes in basic conditions are immediately possible. The problems are of the type that require step-by-step rebuilding.

Many energy speeches and papers describe the problems we face, shortages, skyrocketing prices, depleted resources, and so on. None of this, as my remarks indicated today, applies to uranium fuel. Somehow the excesses of uranium and the deficiencies of other fuels have to be brought into

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balance. The waiting may be difficult for all associated with nuclear power, but may be most difficult for uranium suppliers.

Suppliers will be affected in large measure both by the physical condition of the nuclear power industry *and* by the policies of those in the utility industry. The latitude now available in the policy-making arena, and thus, the potential impact of change, is greater than ever before.

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SPECIAL REPORT JUNE 1981

Uranium: A Market In Transition

A Speech
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Uranium:
A Market In Transition

A Speech

by

George White, Jr.
Senior Vice President
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Southern African Metals and Minerals
In a World Context

A Conference Sponsored by
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Metal Bulletin Congresses Ltd.

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Uranium:
A Market In Transition

INTRODUCTION

In early May 1981, Mr. George White, Jr., Senior Vice President of Nuexco, delivered a paper on uranium at a conference sponsored by Metals & Minerals Research Services Ltd., and Metal Bulletin Congresses Ltd., two London-based firms. The conference entitled, Southern African Metals and Minerals in a World Context, was held in Johannesburg, South Africa, on May 11-12, 1981.

A slightly edited version of Mr. White's paper appears in this Special Report.

It is a pleasure to be here with you in South Africa, and while my remarks are unlikely to be particularly good news for uranium sellers, I trust you will remember that Nuexco merely reports the market. Consequently, you should not find it necessary to shoot the messenger.

To begin, let me go straight to the bottom line of the current market situation.

1. Uranium prices are down sharply from the highs attained in the latter half of the 1970's.
2. We see little likelihood of any price recovery in the near term or for that matter prior to the mid- or late 1980's.

Figure 1 is a graphic representation of the Exchange Value in current dollars from 1970 to March 1981. As you are well aware, prices were essentially flat in the period 1970-1973, had a meteoric rise in the period 1974 through mid-1976, were essentially stable from mid-1976 through year end 1979, and have been in decline since then.

Figure 1 does not, however, tell the full story of the price decline. Figure 2 focuses on the period 1976 through the present and the Exchange Value has been adjusted to constant April 1976 dollars. We can see the February 1981 Exchange Value of $25 is equivalent to only $15.27 in April 1976 dollars.

Another way to look at this situation would be to use the February Exchange Value of $25 as a base and adjust backwards. The results of this adjustment are seen in Figure 3. Here we see that, in constant February 1981 dollars, the Exchange Value at its peak in April of 1976 was equivalent to $65.49 per pound U_3O_8.

To avoid confusion, let me note here that throughout this paper, dollars are US dollars, and quantities of uranium are millions of pounds U_3O_8. The index utilized in Figures 2 and 3 is the Producer Price Index, published monthly by the US Bureau of Labor Statistics.

I previously noted that we see little likelihood of a price recovery in the near or intermediate term. Two basic reasons argue against higher prices. One factor is the existent and perceived future imbalance between production and consumption. The dimensions of this imbalance are quite beyond those existing in any other commodity of which I am aware. The second reason relates to the cost structure of world production with particular emphasis on Australia, Canada, and South Africa.

PRODUCTION AND CONSUMPTION

During 1980, the United States produced about 42 million pounds U_3O_8. However, US utilities only burned about 18 million pounds to produce electricity. Before you brush this aside as a phenomenon unique to the US, you should recognize that the same approximate ratio also pertains to the world market. Nearly 110 million pounds U_3O_8 were produced, but only about 40 million were turned into electricity. I submit that this is not a situation conducive to price strength. Let me define my use of the word "world" as WOCA or World Outside Communist Area.

Production in excess of consumption results, of course, in increased inventory, the impact of which represents perhaps the greatest unknown in the uranium equation. While there is general agreement about the size and location of uranium inventories, there is, nonetheless, a good deal of mystery as to how these growing stocks will effect the future market. I would like now to consider these three elements: consumption, production and inventory.

Of the three, consumption is the easiest. It is merely the arithmatic summation of what each reactor requires year by year. Given any population and mix

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Figure 1
NUEXCO EXCHANGE VALUE
Determined as of the last day of the month
(U.S. Dollars/Pound U_3O_8)

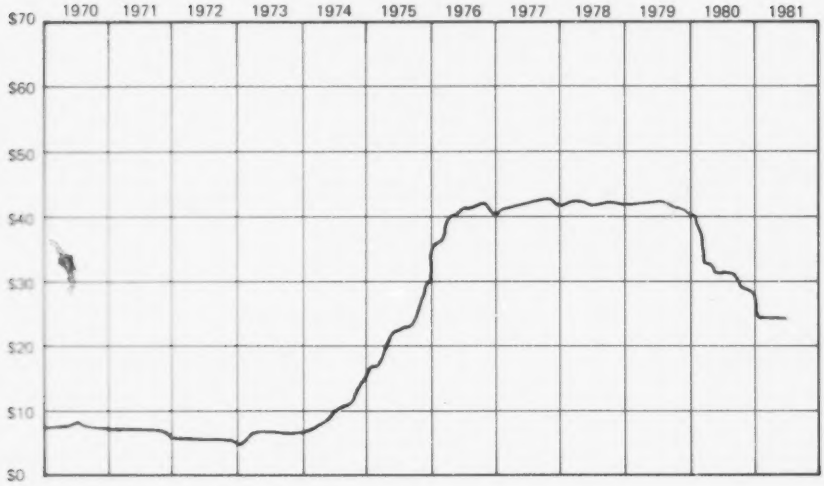

Figure 2
NUEXCO EXCHANGE VALUE EXPRESSED IN CONSTANT APRIL 1976 DOLLARS
Determined as of the last day of the month
(U.S. Dollars/Pound U_3O_8)

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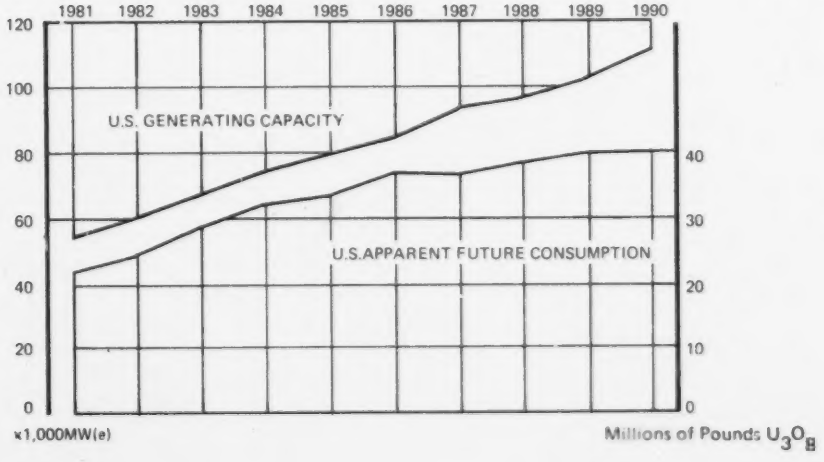
Figure 3
NUEXCO EXCHANGE VALUE EXPRESSED IN CONSTANT FEBRUARY 1981 DOLLARS
Determined as of the last day of the month
(U.S. Dollars Pound U_3O_8)

Figure 4
U.S. NUCLEAR GENERATING CAPACITY AND U.S. APPARENT FUTURE CONSUMPTION



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of reactor types, one can construct algorithms that forecast uranium consumption. Assumptions must indeed be made regarding such variables as enrichment tails assay, capacity factors and improvements in fuel design. But again, these are reasonably simple computations. By far the most crucial factor of the consumption picture and the most difficult to gauge is the date when individual reactors will go into operation and begin to consume uranium.

In the US, as a consequence of financial and regulatory constraints and lagging load growth, construction times have lengthened to between ten and 12 years. It is thus possible to say that in 1990, no more than 112,000 MWe nuclear will be in operation, and, therefore, uranium consumption will not exceed 41 million pounds U_3O_8 as Figure 4 shows. It is practically inconceivable that consumption could exceed this amount. However, based on recent experience it is possible, even highly probable, that additional delays and cancellations will reduce this amount still further.

It is also possible to make educated estimates addressing the world situation, although the picture is a bit more difficult to gauge due particularly to uncertainties with respect to France and Japan. If one excludes these two countries, an analysis much like that done for the US can be made. Specifically, it is possible, based on reactors in operation, under construction and on order, to estimate a credible maximum for 1990 online nuclear capacity for most of the significant nuclear power nations. From the capacity total, figures for uranium consumption follow. Numbers for France and Japan, as a consequence of their licensing procedures and shorter construction schedules, have to be more general because, to a certain extent, *some* reactors *not yet on order* may be ordered, licensed, built and begin consuming U_3O_8 before 1990. Figure 5 is a graphic presentation of Nuexco's consumption estimates between 1981 and 1990 including the US. For those of you who may view our estimates of installed capacity as overly conservative, I will offer you an alternate scenario later in this paper utilizing higher consumption estimates for France and Japan.

It should be noted that Apparent Future Consumption of uranium concentrates is specifically defined as the theoretical calculation of a U_3O_8 requirement. It is the amount of U_3O_8 required to enter the fuel cycle process at the U_3O_8-UF_6 conversion plant in order for fabricated fuel to be ready for reactor loading as needed. As such, it is conceptually different than demand. Demand is that quantity of material which the buyer believes he needs or says he needs; it is the measure of a buyer's market impact. Thus, a buyer's demand may be greater or less than anticipated consumption because he may wish to create, add to or liquidate inventory.

Now regarding supply, I noted earlier that worldwide production was about 110 million pounds U_3O_8 during 1980. We anticipate that production will gradually approach 120 million pounds U_3O_8 by 1987 before falling off slightly at the end of the decade. This growth is greater than it may at first appear because we expect the US share of such production to decrease from its 1980 level of 42 million pounds U_3O_8 to about 16 million pounds by 1990. Thus, non-US production will increase over the same period from 68 million pounds to nearly 100 million pounds. The principal additions will come from Australia (the Nabarlek, Jabiluka and Ranger deposits) from Western Canada (the Midwest Lake, Cluff Lake, and Key Lake deposits) and from increased production in Africa.

Please note that these data include substantial cutbacks in the US and take into account only those non-US production centers that we judge to be firmly committed. Thus these data *do not include* any contributions from such well known deposits as Mt. Taylor, Nose Rock, Crownpoint, Immouraren and Roxby Downs.

The point is that, even with this conservative view of future production, we have a picture that looks like Figure 6. The lower line shows estimated future consumption. The upper line shows Nuexco's forecast of future production. It is significant that in every year during this decade production is in excess of consumption. This, of course, brings up the question of inventory. At the end of 1980, world uranium inventories held by utilities, convertors and fabricators approached 312 million pounds equivalent U_3O_8. This figure includes U_3O_8, natural UF_6 and enriched product, but excludes producer inventories, material in the conversion-enrichment-fabrication pipeline, and national stockpiles. The most notable omission is the 130 million pounds equivalent U_3O_8 owned by the US Department of Energy.

Thus, if we take a mid-case view of consumption, a conservative view of production, and a conservative initial inventory number we see the picture portrayed in Figure 7. This figure is the same as the previous one with the exception that we have had to change the

Figure 5
WORLD APPARENT FUTURE CONSUMPTION

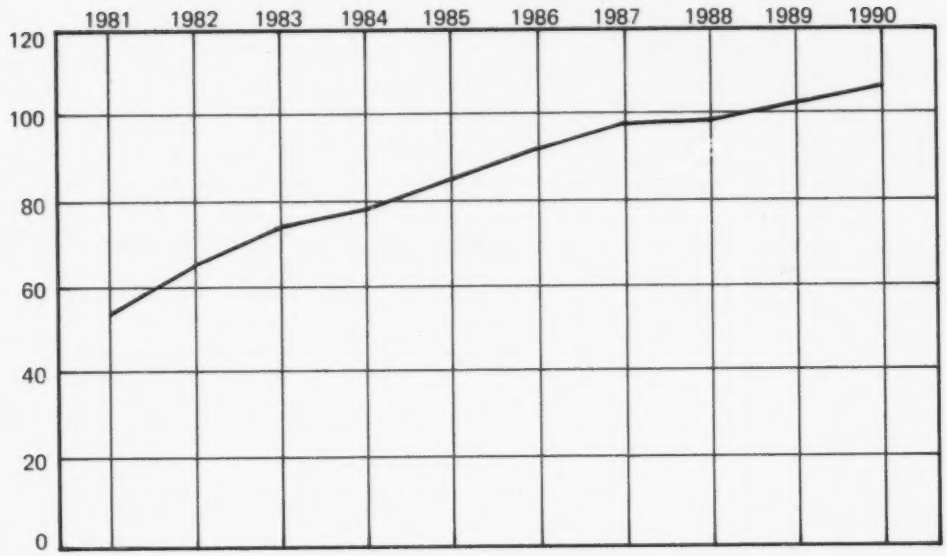

Figure 6
WORLD APPARENT FUTURE CONSUMPTION
vs.
WORLD SUPPLY

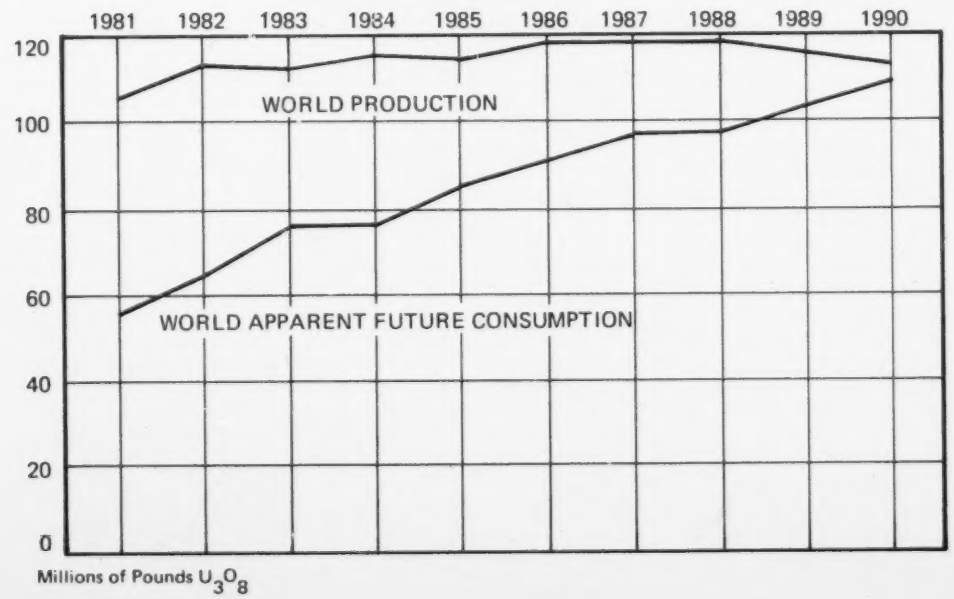

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Figure 7
WORLD APPARENT FUTURE CONSUMPTION
vs.
WORLD SUPPLY AND SHOWING INVENTORY

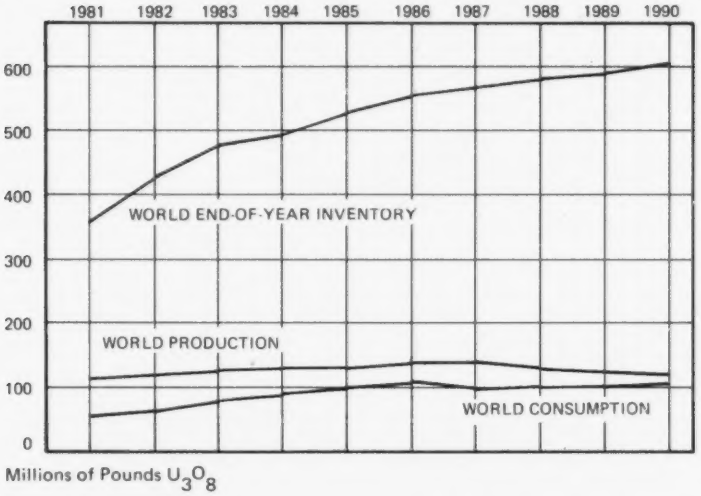
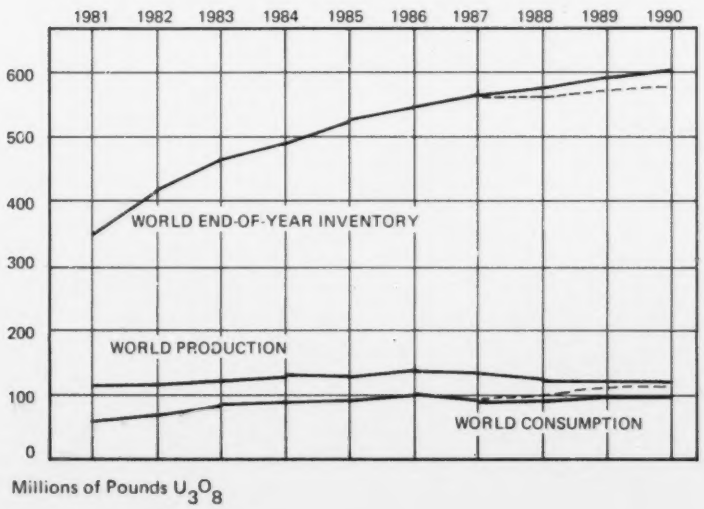


Figure 8
WORLD APPARENT FUTURE CONSUMPTION INCLUDING HIGH CASE JAPANESE AND FRENCH CONSUMPTION
vs.
WORLD SUPPLY AND SHOWING INVENTORY



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scale and have added an inventory line. As you can see, inventory rises steadily during the decade of the 1980's.

For those of you who view our forecast of future consumption as unduly pessimistic, I have constructed Figure 8, another scenario based on more optimistic consumption estimates for France and Japan. The dotted lines indicate the impact of these higher estimates. Increasing consumption while holding supply unchanged obviously results in lower inventory build up. But again, production is larger than consumption in every year through 1990 and thus inventory still continues to build throughout the decade, albeit more slowly.

As I noted earlier, this is not a picture to warm the hearts of existing and would-be uranium producers.

COST STRUCTURE

The second general, but related factor militating against any foreseeable price strength in uranium, is the cost structure of the production industry, with particular emphasis on South Africa and the emerging areas of Australia and Western Canada.

In a perfect economic world, low cost production will, over time, displace high cost production. While the uranium market is far from perfect, and carries particularly onerous burdens in the form of special political considerations and safeguards policies, we nevertheless anticipate that with some exceptions, the lower cost producers will increasingly dominate the market.

When I use the words "low cost", I refer to those operations which can produce U_3O_8 at costs of less than $25.00 per pound U_3O_8 in mid-1981 dollars. The word "cost" as used here includes everything other than return on investment. Production from existing low cost centers, together with that from new low cost centers and that from certain areas where cost considerations are secondary to national prestige or foreign exchange considerations, will be sufficient, or rather more than sufficient, during the decade of the 1980's to satisfy even the most optimistic forecast of future consumption.

Thus, we are looking at a buyer's market for the foreseeable future.

MARKET CONSIDERATIONS

Up to this point, I have discussed production, consumption and inventory only in terms of their current and forecast relative magnitudes. If production exceeds consumption, inventories increase. Logically, this suggests price weakness. However, the uranium market has never been particularly characterized by logic. Some utilities have committed to purchase quantities which are far in excess of any reasonable anticipated rate of consumption. Others panicked and purchased at prices and under terms and conditions that were absurd even at the time the deals were consummated. Some sellers committed future production at prices guaranteed to lose them money on every pound delivered, or even sold short. It is clear that at different times, the various uranium market participants held rather different perceptions about the future.

In any commercial activity, perception of a situation may well prove more important than its actuality. Due to the long lead times involved in the nuclear industry, actions based on such perceptions can have enormous and long-lasting consequences. Consider the entire Westinghouse situation. Consider the US utility which fearing a uranium shortage, contracted with a seller in 1977 at $40 escalated and is now paying over $60 per pound U_3O_8 under a contract that continues until the mid-1980's and under which the price increases $5 to $6 each year.

Consider the Australians who played politics with uranium for so long that they missed the market top and have had to settle for terms and conditions considerably less advantageous than what they could have obtained had they moved more expeditiously.

Utility buyers are fully cognizant of the current facts and trends of uranium production and consumption. As you might anticipate, new procurement activity abated as prices declined. Indeed, why buy today if better terms and conditions are likely to be available tomorrow? And while the cost of production of electricity by nuclear power is relatively insensitive to the price of uranium, I can assure you that buyers of uranium are not insensitive to its price. Sensitivity to uranium price is a function of several factors: geography; the buyers' past market experiences; and finally and perhaps most importantly, the condition of the market. The corollary to price sensitivity is, of course, concern about supply assurance. Thus you have the picture seen in Figure 9. While hardly a startling revelation to this group, the short history of the uranium market, the dramatic price movements, and the unique nature of the buyers have led to some extreme market behavior.

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The sometimes unusual buyer conduct is related to the fact that utilities are unique business organizations. The charter of the utility company, namely, reliable service, dictates a strategy of risk avoidance. There is, in fact, little incentive to take risk, and substantial motivation to avoid it. In business philosophy a utility represents the exact opposite of a mining company. Miners and other industrial enterprises may well and often do take large risks in expectation of commensurate rewards.

Consider the utility uranium buyer. If he successfully buys uranium below market price, the benefits flow not to the company, but to the utility customer in the form of cheaper electricity. If, on the other hand, he pays $45 per pound when market price is $30, he is at the very least, embarrassed in front of his management which will ask him why the company is paying $15 more than the current rate. More importantly the company may be called to task by regulatory authorities. Why take the chance? In the US we have seen the extreme threat requiring that the utility's shareholders rather than the utility customer absorb that extra $15.

Thus, risk avoidance translates into a desire to purchase at market price. Who can criticize you for buying at market? You are merely paying the "going rate."

US utilities, in general, now refuse to enter contracts where the price mechanism might require them to pay more than market. This leads to a "Catch 22" situation for the producer. A guarantee to deliver at market price can, of course, result in delivery at prices below costs of production. New producers in need of outside financing would surely find that such contracts were not bankable.

European and Japanese buyers, compared to the price-sensitive Americans, historically have been observed as taking a longer view of supply arrangements. I would generally agree with this position. However, it would be a mistake to overstate the case. Once supply is assured and more particularly, once an oversupply condition exists, even the conservative Japanese will exhibit price sensitivity. During the past two years they have negotiated successively lower prices with their long-term suppliers. Further, it is our understanding that the Japanese, motivated by the continued softening of market conditions have requested renegotiation of some 1981 prices that were agreed to during 1980.

Having made these comments, it is appropriate to address the question of Australia. While a late comer to the supplier field, Australia has enormous reserves which will almost surely increase further if and when new exploration is undertaken, particularly in the Northern Territory. Based on the size and grade of its reserves and existing government commitments, it seems clear that Australia is bound to become one of the major uranium export suppliers.

There has been a good deal of publicity about the terms and conditions under which Australian material has been sold. These are reported to include minimum prices which are higher than current market levels, market price features and close government review. It would be quite natural to ask, in the light of my previous comments, how the Australians were able to accomplish this.

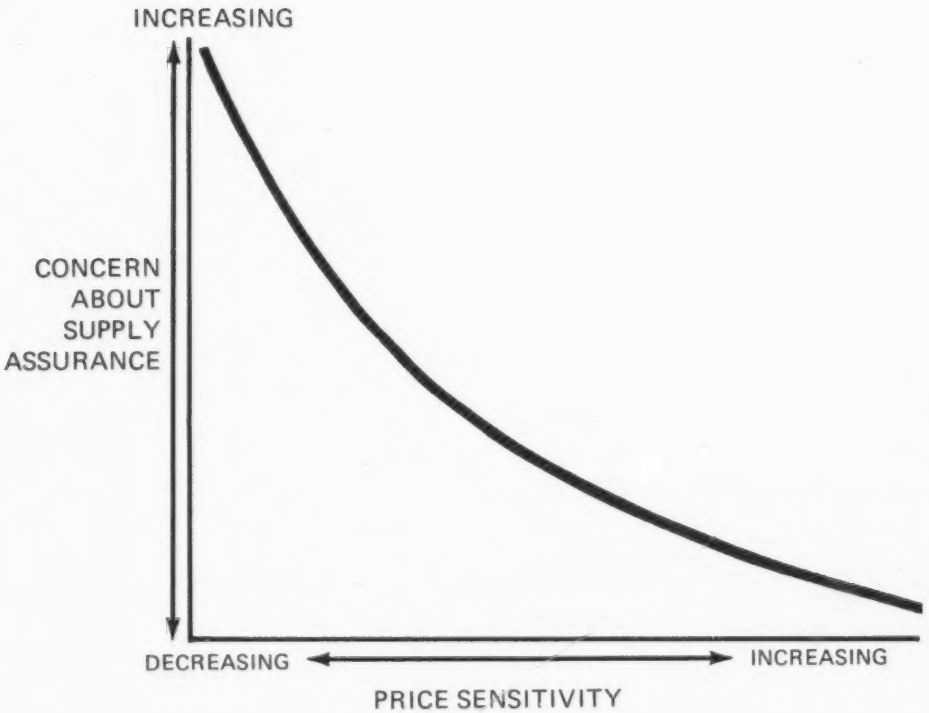
The answer is rather straightforward. Buyers were anxious to encourage Australian committment to uranium production, to get Australia into the game, to provide additional geographic supply diversity and to add a competitor to Canada and South Africa.

The price of insuring Australia's market entrance to an individual buyer is relatively modest—a premium price for a few years on a relatively small portion of total needs. I personally believe that if prices remain at current levels the initial round of Australian contracts will, in all likelihood, be renegotiated once the Australian government finds a politically defensible means to amend its current policies. Please recognize that this is a personal view.

The Canadian sellers, more particularly the Saskatchewan sellers, are also currently in the market. They are active and quite aggressive in the marketing of their large, extremely high-grade deposits. While the Canadian government is involved in export sales approval, it has of late kept a relatively low profile and appears to be developing policy contemporaneously—namely, doing what is necessary to maintain and gain market share.

Before commenting on Southern Africa, I would like to address two other market-related topics. The most likely future scenario for the industry involves substantial cutbacks of US production as current delivery commitments expire and US producers are unable to compete at foreseeable market levels. As US consumption grows, foreign production will fill an increasing share of US needs. Concern has been expressed by non-US producers about a reimposition of the US uranium embargo. After all, we closed our

Figure 9
PRICE vs. SUPPLY ASSURANCE



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market to foreign uranium until 1977, and only last year an unsuccessful attempt was made in our US Senate to reimpose such an embargo.

We do not anticipate a reimposition of any meaningful embargo. The complete rationale is rather lengthy and I will only highlight it briefly here.

1. Primary beneficiaries of a new embargo would be the oil companies. It would be politically unattractive and dangerous to appear to hand more money to these organizations.
2. The dollar volume of the US uranium industry is too small, only about $1 billion annually, to risk the enormous political problems that might be created with such major trading partners as Canada and Australia.
3. The involved regions in the US, namely, Wyoming, New Mexico and Utah are thinly populated and lack political clout.
4. An embargo would meet fierce opposition from the US utility industry and would place the embargo's sponsors in the position of advocating higher energy costs. Politically, this could be very risky.
5. Most important, there is no need for an embargo. Unlike oil, US uranium inventories are huge and growing. In addition to industry inventories, we have a national stockpile. Further our resources in the ground are sufficient to fuel any conceivable level of nuclear power development well into the next century. The US cannot be "OPECed" in uranium.

One is led to the statement, as a friend of mine suggested, "Let's leave our uranium in the ground and rape Australia, Canada and Africa for their resources."

Next, I would like to comment briefly on the inventory situation. For whether or not one agrees with our specific forecast of inventory growth in the long term, there can be no argument but that inventories will increase substantially in the years ahead.

It is equally clear that his inventory is having an impact in the marketplace. This impact takes several forms. The most obvious is the resale of excess material by buyers. Whether motivated by need for cash or regulatory considerations, the effect of this resale is to put downward pressure on the near-term price structure. During 1980 and early 1981, utilities and other buyers have been sellers of several million pounds U_3O_8. We anticipate a continuation of this trend.

Second, the continued inventory growth has the effect of delaying the time when additional material is required, which in turn tends to defer new contracting. The producers, of course, counter with more aggressive marketing, lower prices and other improved terms. The existence of inventory obviously alters the buyer's negotiating posture, normally hardening that posture.

Finally, a more subtle shift in assurance of supply thinking is becoming apparent, as some utilities have determined that there is no compelling reason to carry any inventory at all. With total inventories growing they believe that, even in the event of supplier default, they would have no trouble acquiring the needed material in the spot market, from other utilities or from national stockpiles. Such belief is probably well placed today. It is inconceivable under current market conditions that any reactor could fail to operate due to lack of uranium. Neither the government involved nor neighboring utilities would allow it.

Producers will do well to study the inventory situation: the rate of build-up; its distribution not only by country, but also by utility within countries; the changing utility attitudes as to appropriate inventory size; the imbedded price of existing inventory; as well as the interface with any government stockpiles.

As an American coming to South Africa for the first time, I might be excused for having the normal biases imposed by exposure to the US media. Fortunately I have had the opportunity to know and work with a number of South Africans and believe I've been somewhat deprogrammed.

It is nevertheless true that some buyers perceive Southern Africa as the least stable of the major producing areas. Please note that I said perceive, and recall that the perceivers are utilities, mostly US utilities, bent on risk avoidance. These perceptions include: the uncertain situation in Namibia; questions about the long-term stability of South Africa; and the omnipresent public relations aspects of South Africa's racial position. For these utilities, long-term contracting from Southern Africa is not likely in the present climate. Individual fuel managers recognize the exemplary delivery record and the high standard of South Africa's product, reported to be the world's most uniform in quality. However, their restraint is institutional in nature.

As you are well aware, other buyers in Europe and the Far East, as well as some non-utility US buyers, have enjoyed excellent commercial relationships with

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